Cover page: 17th century engraving by Pieter Jacobsz van Laer of Haarlem, dit Bamboccio, (1599-1642), representing a livestock farm in the Latium region of Italy

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ICAR Technical Series no. 9

Development of Animal Identification and Recording Systems for Developing Countries

Proceedings of the ICAR/FAO Seminar held in Sousse, Tunisia, 29 May 2004

Editors: R. Pauw, S. Mack & J. Maki-Hokkonen

October 2004

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Foreword

There is an increasing interest worldwide in animal identification and recording (I&R) systems both in developed and developing countries. The reasons for this interest are varied. Traditionally I&R systems were developed as an essential element in breed improvement programmes and have been fundament to the establishment and maintenance of pedigree herds and flocks. More recently, the advent of BSE and the recent outbreak of Foot and Mouth Disease (FMD) in Europe has lead to importing countries to demand complete traceability of all animals products they import. Veterinary authorities increasingly see the need for a reliable I&R system as a prerequisite to enforce the control of transboundary diseases. In many developing countries, however, there is now another equally important reason to implement I&R schemes - stock theft. In some countries in southern Africa, the problem is getting so bad that farmers are no longer willing to take the risk of keeping animals at all.

Whatever the reason for wanting to introducing I&R schemes, the basic prerequisites remain the same. These are:

a) a system that is practical and meets its expectations;
b) a system that is supported by an appropriate legal framework as well as by the producers and trade, and
c) a system that is sustainable and self-supporting.

It is this increasing interest to establish I&R systems, especially from developing countries, that resulted in FAO and ICAR collaborating to put on a seminar at the 34Th ICAR Session, held in Sousse, Tunisia, in May 2004 entitled “Development of Animal Identification and Recording Systems for Developing Countries”. The seminar provided an overview of the role played by the ICAR Sub Committee on Animal Identification and its use by ICAR members. A comprehensive review of animal identification techniques from the ‘fire’ to the ‘electronic’ age was provided by Dr Gerardo Caja and his colleagues from the Universitat Autònoma de Barcelona. The viewpoint presented by a number of consultants responsible for designing and implementing I&R systems proved particularly interesting. FAO assisted in bringing in speakers from a Africa, South America and Asia to present the diversity of I&R systems in the developing world, their constraints and successes. Throughout the seminar, there was an excellent level of debate and discussion from the floor which resulted in an agreed and manageable set of conclusions to be followed by ICAR and FAO.

Personally, and on behalf of FAO, I would like to thank the ICAR Secretariat for their efficient handling of the logistics and also for the timely preparation of these proceedings. Prof Guellouz and the local organizing committee who ensured that the workshop ran smoothly, who got everyone to and from the airport, and, not least, for their amazing hospitality. And, finally, to all those participants who came to the seminar and whose contribution made it such a success. Thank you.

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Introduction

Identification and registration (I&R) are important tools at all stages of an animal's life, as well as in any part of the food production process e.g.

- farm management,
- animal recording,
- animal breeding,
- animal health and disease surveillance,
- beef labelling,
- trade descriptions,
- control of subsidies, etc. and
- contribute to providing consumer protection

The new international rules on certification of the origin and health of live animals or food of animal origin traded either locally or internationally have created an opportune moment for the development of standardized animal identification and registration (I&R) systems. Particularly the potential exporting countries in the developing world need to be more prepared to meet the requirements of the importing countries imposed on live animals or products of animal origin. This new situation in the regional and global trade offers a unique opportunity to create harmonious systems / blueprints for animal identification and registration which have never before been sufficiently attractive from herd management or local health control needs only. This goal is now becoming realistic driven by world trade requirements and could eventually benefit livestock development in many ways.

It has been recognised by ICAR and its Sub-Committee on Animal Identification for many years, that standardisation of procedures and equipment is needed to guarantee accuracy of individual animal identification in any kind of recording or tracing procedure. FAO within its scope has initiated several pilot projects to introduce standardized animal identification and recording systems for developing countries.

Both organizations, FAO and ICAR, felt the need to bring together experiences in defining procedures and results of different field approaches for I&R in a Seminar especially aimed to promote introduction of such systems in developing countries.

The workshop was carried out in the frame of the ICAR biennial session in Tunis, May 2004 with speakers and participants coming from all regions of the world. Papers given at the workshop together with some draft conclusions and recommendations are published in the present volume of the ICAR Technical Series. They will hopefully serve as a first draft information on I&R systems used in developed and developing countries. In addition, this volume of the Technical Series includes the

full report on a questionnaire carried out by the Sub-Committee on Animal Identification on I&R systems in ICAR member countries in 2003 (Thanks to O.K. Hansen for data collection and evaluation as well as P. Bailey for editing the report). May this serve as a reference on the current state-of-the-art regarding I&R in different parts of the world. Finally the editors wish to express their gratitude to ICAR and FAO for supporting the workshop including the publication and to Cesare Mosconi for thorough preparation of this publication.

The Editors:
Reinhard Pauw
Simon Mack
Juhani Maki-Hokkonen

Rome, October 2004

Role and work of the ICAR Sub-Committee on Animal Identification

Reinhard Pauw

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Summary

The role and the work of the Sub-Committee on Animal Identification is reviewed. Beside regular meetings and other general activities, the work of the Committee is mainly focussed in setting up guidelines and procedures for the testing of identification devices with regard to their conformity to the current ISO standards and their performance in the field. Testing is based on several protocols elaborated by the Sub-Committee after discussion with the identification industry and related parties. In the field of Radio Frequency Identification Devices (RFID), 84 transponders of different types have been successfully evaluated since the beginning of the procedure and may officially be used in animal identification. A first tests for ISO compliant readers has also been carried out recently. Furthermore, a procedure for the evaluation of conventional plastic eartags to be used in official identification programs has been prepared and will be set into force soon. An important part of the Sub-Committees work consisted in the elaboration and evaluation of a questionnaire on animal identification issues regarding farm animals among ICAR member countries.

Keywords: identification, registration, transponder, reader, eartag, conformity, performance, ISO standard.

Introduction

Unique identification is a basic requirement for all activities where individual animal recognition is necessary, e.g. farm management, animal recording, animal breeding, animal health, disease eradication/prevention, beef labelling, purposes of trade, control of subsidies etc. The necessity of functioning identification and registration systems especially in disease prevention situations has become obvious during the outbreak of Foot and Mouth Disease in some countries of the European Union (EU) as well as during the recent BSE crisis.

The importance of unique identification for all kinds of performance testing and subsequent evaluation of productivity in livestock has been recognised by the International Committee for Animal Recording (ICAR).

For this reason, ICAR, an "international non governmental non profit organisation" (INGO) with more than 50 members all over the world created a "Working Group on Animal Identification and Registration" by the end of the 1980s. According to the vote of the General Assembly in 1998, the working group was modified to be the "Sub-Committee on Animal Identification". The Sub-Committee on Animal Identification is one of three Sub-Committees within ICAR's operating structure (see Figure 1). Within its terms of reference, the Sub-Committee on Animal Identification covers the following subjects related to identification and registration:

- Preparation of guidelines for the relevant appendices of the International Agreement on Recording Practices
- Stimulation of new developments in and report on new equipment, procedures and methods dealing with:
  - Electronic identification;
  - Other identification devices;
  - Standardised layout of eartags for individual animals.
- Advising the ICAR Board on approval and/or certification of:
  - Institutes serving as ICAR test centers;
  - Identification devices used in individual animal identification.

According to the terms of reference, the work of the Sub-Committee on Animal Identification is focussed mainly to the following subjects/issues:

1. meetings and miscellaneous general activities;
2. organisation of device testing; and
3. publication/evaluation of a questionnaire on I&R of farm animals in ICAR member countries

Meetings and miscellaneous general activities

Currently, the Sub-Committee has seven members and, occasionally, guests and observers attending the meetings held at least once a year. Members of the Sub-Committee regularly attend ISO/TC 23/SC 19/(T)WG3 working group sessions where international standards in electronic identification (RFID=Radio Frequency Identification Devices) are prepared. In these meetings the Sub-Committee presents and discusses guidelines on conformance testing of RFID-transponders/-readers and performance testing of RFID-transponders/-readers. Furthermore members of the Sub-Committee keep close contacts to national/international bodies with responsibilities in animal identification e.g. to the Commission of the EU prior to the publication of the new regulations. Relationships to other relevant organisations in animal identification also exist e.g. with the World Small Animal Veterinary Association (WSAVA).

Within miscellaneous general activities, the work of the Sub-Committee also consists in handling requests from ICAR members, the industry and interested parties on animal identification issues.

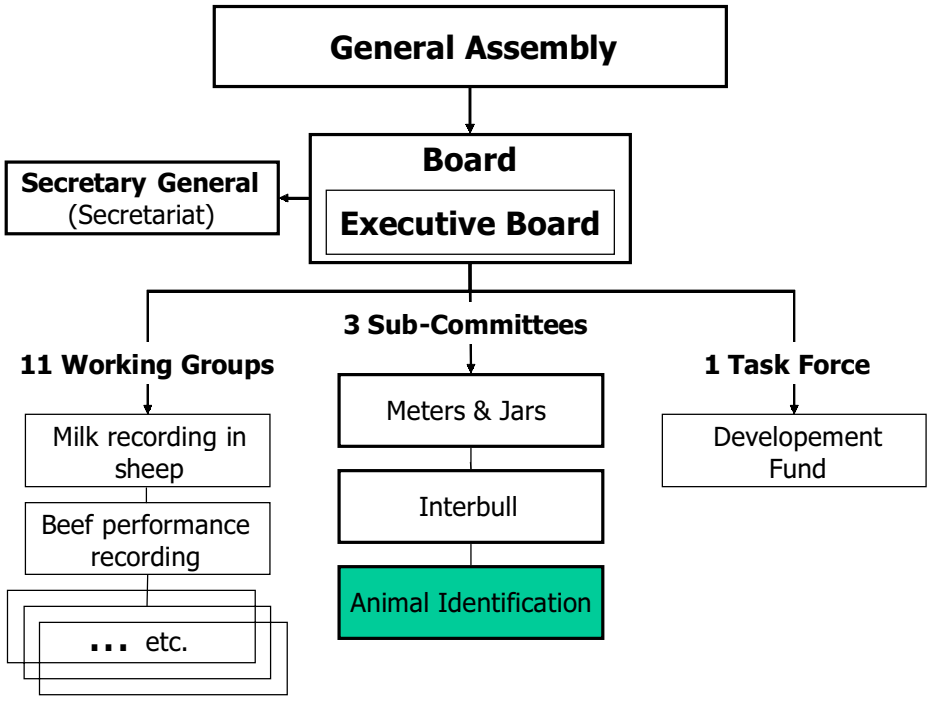

Figure 1. Operating structure of ICAR and the position of the Sub-Committee on Animal Identification.

Organisation of device testing

In general, the activities of the Sub-Committee with regard to the testing of identification devices can be sub-divided into two main categories as illustrated in Figure 1:

- **Conformity testing**
  This kind of testing has to be applied if the function and the use of identification devices are bound to any kind of official regulation. An example for conformity testing is the test of transponders and readers concerning their conformance with the ISO standards 11784/11785. In general, the submission of identification devices to conformity testing is obligatory previous to their application in the official identification of animals. Conformity tests are carried out by officially authorised institutions (e.g. ICAR being appointed by ISO as Registration Authority to perform conformity tests on transponders).
- **Performance testing**
  Performance testing is a mandatory option for checking the utilisation of identification devices in practical application. The objective of this kind of testing is to provide neutral information concerning the special characteristics of identification devices to the end-user, e.g. farmer/owner. While conformity testing is mainly carried out in

laboratories, the most important part of performance testing is field testing. ICAR is currently introducing a performance test for transponders (extended laboratory test) and a performance test (application / field test) for eartags used in official identification schemes (see Figure 2).

The Sub-Committee has set up several guidelines describing the procedures on how to test devices and grant approvals for successfully tested identification equipment. Through this the Sub-Committee has contributed to the extension of the "International Agreement on Recording Practises" with reference to Section 1: "ICAR Rules, Standards and Guidelines on Methods of Identification".

Conformity Testing of Radio Frequency Identification Devices (RFID)

Conformity testing of RFID-transponders is based on the ICAR guideline "Conformance evaluation of RFID-devices, Part 1: ISO 11784 / 11785 , conformance of transponders including granting and use of a Manufacturer Code for ISO compliant transponders". Since the beginning of this test activity in 1995, 49 manufacturers applied for participation. Altogether 84 transponders have successfully passed the tests at the ICAR test centers. In the end, participation to this test aims at receiving a manufacturer code. The manufacturer code is necessary to ensure unique identification numbers as long as national databases do

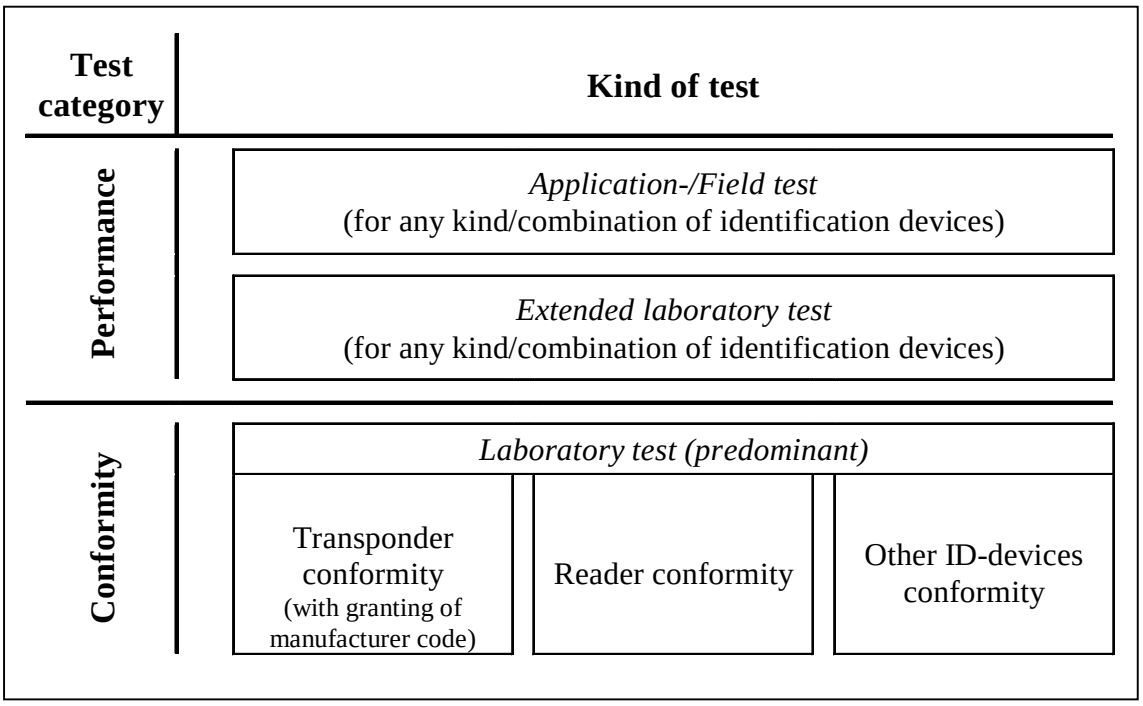

Figure 2. Categories for the testing of identification devices.

not exist and, therefore, is a prerequisite to start commercial production and distribution of transponders. ICAR offers 3 types of tests: a full test (for the first transponder or in case of modification in technology), a limited test (for transponders with a modification in primary / secondary packaging) and a listing update test (for transponders already tested in the full / limited procedure for one manufacturer and to be used by a second manufacturer). In general, the transponders tested so far can be classified as follows:

- Injectable transponders (small size transponders able to be injected into an animal's body and encapsulated in a biocompatible and non-porous material, i.e. glass).
- Electronic eartag transponders (plastic covered transponders able to be fixed to the ear of the animal using a locking mechanism or to be attached in non-reversible way to an eartag).
- Electronic attachment transponders for application with conventional eartags.
- Electronic bolus transponders (transponders placed into a high specific gravity container able to be orally administered to a ruminant and remaining permanently in its fore stomachs).

The results of the tests together with a photograph are published via the ICAR web page (www.icar.org, see Figure 3).

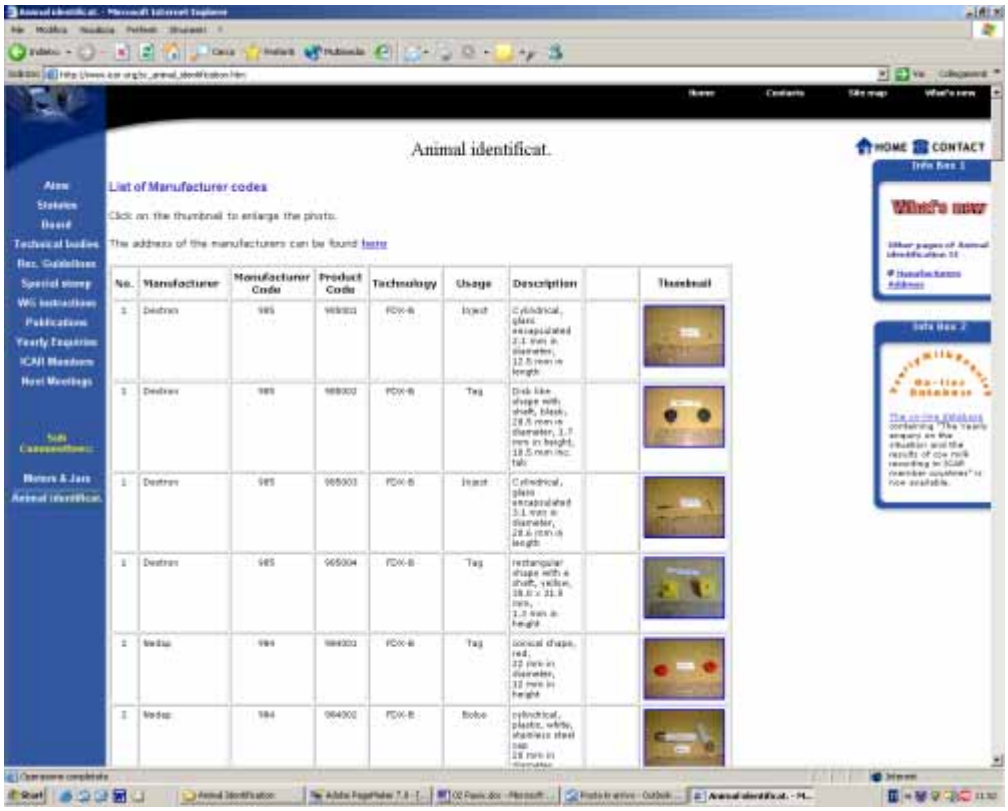

Figure 3. The results of the tests are published on ICAR's web page (www.icar.org).

Conformity testing of RFID-readers is based on the ICAR guideline "Conformance evaluation of RFID-devices, Part 2: ISO 11784/11785, conformance of transceivers". The first reader test on ISO conformity, i.e. capability of reading both HDX and FDX-B transponders, has been carried out in May 2002.

Performance testing of official identification devices

An important activity of the Sub-Committee during the past years was the setting up of a guideline for testing conventional eartags titled "Performance Evaluation and Approval of Official Identification Devices, Part 1: Conventional permanent plastic eartags with or without machine readable printings." From experiences gained in several practical applications it became obvious that there is a potential need to have reliable test results for eartags used in official identification schemes. These results are not only of importance for the farmers but also for competent authorities responsible for the supervision of animal identification and registration rules. The whole testing procedure for conventional eartags is subdivided into three main subsections as follows:

1. Participation in the test procedure to obtain ICAR approval (General remarks);
2. Description of laboratory/field tests and assessment procedures (Laboratory test, preliminary field test, extended field test);
3. Conditions for granting, maintenance and use of approvals (Provisional approval, full approval, withdrawal of approval).

A thoroughly prepared draft has been discussed with the industry during several joint meetings. The draft was generally accepted. After incorporation of some minor corrections and amendments, this document will be submitted for approval by the ICAR Board in May 2004 with the first test run to be started in the second half of 2004.

ICAR approved test centers

To accomplish its tasks within testing of identification devices, ICAR co-operates with two test centres. They perform the conformity tests on RFID devices according to the ICAR guidelines. Test centres have to be approved by the ICAR Board and are audited on a regular basis by members of the Sub-Committee. Enhancing its testing activities, ICAR is interested in having more test houses preferably located in ICAR member countries.

Questionnaire on I&R of farm animals in ICAR member countries

During 2003, the ICAR Sub-Committee on Animal Identification carried out a survey on animal I&R systems worldwide covering cattle, sheep, goats and buffaloes. All ICAR member organisations received a questionnaire configured in a way that made it possible for the participants to enter information on almost any type of identification system from tattooing to electronic identification. Member organisations were encouraged to report on all systems used in their countries or regions. Altogether, answers were received from 100 I&R systems, 39 for cattle

26 for sheep, 28 for goats and 7 for buffaloes. The geographical distribution of identification systems covered all continents except for Asia. 64 % of all answers regarding cattle systems came from EU member states or EU new member states, 10 % from European countries outside the EU and 26 % from outside Europe. The distribution of answers concerning other species was similar to that of cattle. Unfortunately, the questionnaire did not provide many answers to questions concerning I&R in developing countries. A report on the results is given by O.K. Hansen, starting from page 9 of these Proceedings.

Conclusions

Beside other activities within the terms of reference, the Sub-Committee has made considerable efforts to prepare guidelines for testing and approval of identification devices used in official animal recognition. The guideline on conformance testing of RFID transponders and granting of manufacturer codes is well established and accepted. ICAR's role in this field is enforced by ISO through the appointment as an official ISO Registration Authority. In addition, a test protocol for conventional eartags to be used in official identification schemes has been finished and will be set into force in the second half of 2004. With its activities in evaluation of identification devices the Sub-Committee provides useful information for administrations, organisations and farmers regarding the practical value of identification devices. The Sub-Committee is going to extend its agenda also to identification and registration matters in sheep and goats.

Level and use of I&R by ICAR Members

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Summary

During 2003, the ICAR Subcommittee on Animal Identification performed a survey in all member organisations. The aim of the questionnaire was to provide a survey of the present situation of identification and registration (I&R). It was not the intention to provide recommendations or guidelines, but hopefully inspiration may be derived from looking at the systems reported. It should be noted that most answers were received from European countries. For this reason the survey is unintended heavily influenced by EU legislation.

Key words: ICAR, identification, recording, eartag, bolus, traceability, cattle, sheep, goat.

Introduction

Animal identification and registration (I&R) are changing from being voluntary farmer-designed systems facilitating management and breeding purposes at farm level to becoming mandatory government-designed systems facilitating also food safety, animal traceability, animal health and other purposes (e.g. premium and environmental control). This can have quite large consequences for animal producers in countries where I&R are not developed and used at a certain level. Food safety policies in some countries may rule out the above-described countries as suppliers of animals and animal food products.

Questionnaires on I&R

During 1993, the European farmers' organisation COPA/COGECA made a survey (questionnaire) in EU countries on animal I&R systems. The reason for the questionnaire was the new EU-regulation on animal identification (Council Directive 92/102), and the questionnaire formed a good basis for further development and for establishing minimum guidelines for species to fulfil requirements for traceability, animal health, animal breeding and for control of premium payments.
During 2003, the ICAR Subcommittee on Animal Identification made a survey on animal I&R systems worldwide covering cattle, sheep, goats and buffalo. All ICAR member organisations received a questionnaire build in a way that made it possible for the participants to enter information on almost any type of identification system from tattooing

to electronic identification. Questions concerning identification could be answered without answering questions on registration. Thus almost any system would be able to fit in the questionnaire. Member organisations were encouraged to report on all systems used in their countries or regions. A report on the questionnaire will be available from ICAR shortly. This paper is a brief summary of the report.
Answers were received from 100 I&R systems:

39 cattle systems
26 sheep systems
28 goat systems
7 buffalo systems

The geographical distribution of cattle systems reported on in the questionnaire:

Africa: 4 systems
Australia: 2 systems
EU countries: 17 systems
EU-joining countries, 2004: 8 systems
Rest of Europe: 4 systems
North America: 3 systems
South America: 1 system

64 % of all answers as regards cattle systems came from EU or EU-joining countries. 26 % of the answers came from outside Europe. The distribution of answers concerning other species was much similar to the one of cattle. Unfortunately, the questionnaire did not provide many answers to questions concerning I&R in developing countries. However, much inspiration may be derived from looking at the answers received.

Cattle systems

Identity and tagging

97 % of the reported systems used unequivocal lifetime identities. The questionnaire had plenty of options for reporting systems with identities that might change during the lifetime of an animal, but only one such systems was reported (temporary movement tags in Sudan). The unequivocal lifetime identity facilitates full traceability of animals and combines data on the same animal from different registration systems.

Description of cattle system	Percent of answers
Mandatory permanent ID-system for all animals, unequivocal lifetime ID	85
Mandatory permanent ID-system for herdbook animals, unequivocal lifetime ID	8
Mandatory permanent ID-system for disease control, unequivocal lifetime ID	3
Mandatory temporary ID-systems (movement tags)	3
Voluntary ID-systems for herdbook animals, unequivocal lifetime ID	3

92 % of the reported systems had governmental requirements attached. Please bear in mind that the majority of the answers came from EU and EU-joining countries. This may not reflect the situation worldwide.

Description of cattle system	Percent of answers
Governmental mandatory ID-system at animal level, no official database	0
Governmental mandatory ID-system and database at animal level	82
Governmental mandatory ID-system at group level, no official database	3
Governmental mandatory ID-system at group level and database	8
No governmental requirements	8

In 53 % of the reported systems the animals must be identified (tagged) within seven days from birth. 14 % of the reported systems allow identification to happen more than 30 days after birth. In 82 % of the reported systems the farmer applies the identification devices, whereas the official identification has to be done by a veterinary surgeon or inspector in the rest of reported systems.

Time of tagging of cattle	**Percent of answers**
Within seven days from birth	54
Within 20 days from birth	22
Within 30 days from birth	11
Within 60 days from birth	3
Within 180 days from birth	3
Before leaving place of birth	5
Temporary tagging at each movement	3

In 82 % of the reported systems the animals are tagged with two eartags for visual identification. In most countries both tags are plastic eartags, but in some countries one tag is made of plastic and the other one of metal. Both eartags must carry the same minimum of information. If one tag is lost, a replacement tag with the same visual ID code must replace it immediately.

85 % of the systems have purely numeric identification codes. 41 % of the systems make use of an ID code that includes a check digit for security reasons. In other systems this has not been found necessary. In 36 % of the systems the ID code is just a serial number without any predefined

connection to farm, region etc. 64 % of the reported systems had ID codes with predefined connections between animal ID and other information (region, farm, organisation).

ID codes for cattle

Visual ID numeric	Visual ID alphanumeric	Check-digit in visual ID	Visual ID purely serial	Visual ID contains region	Visual ID contains farm	Visual ID contains organisation	Visual ID unique, country	Visual ID unique, farm	Visual ID unique, organisation
87 %	13 %	Yes: 41% No: 18 %	36 %	44 %	21 %	10 %	82 %	10 %	3 %

Predefined connections between animal ID and other information (farm, region, organisation etc.) restrict the number of positions available for individual animal ID codes. If one ID code is structured to provide information on two or more items (e.g. animal ID, farm of birth), it will exclude sequences of numbers. In order to facilitate electronic identification (EID), the total individual ID code of each animal must be restricted to a maximum of 12 positions in order to comply with ISO standard 11784, which is the worldwide officially recognised standard for code structure in EID. ID codes must be chosen in a way that no reuse of EID codes should be allowed in foreseeable time (several decades). 82 % of the reported systems applied unique ID codes at national level. Unique numbering at national level should be a standard requirement in modern I&R systems.

Only a few systems with EID were reported. They all use transponders in eartags, in attachments to eartags or in boluses. No reported systems use implanted transponders. Some of the reported EID systems were part of the IDEA project run by EU.

EID in connection with cattle

EID approved	EID in eartag	EID in attachment to eartag	EID in bolus	EID in implant
Yes: 40% No: 60%	20 %	12 %	12 %	0 %

Traceability and database

77 % of the cattle systems require individual registration of each animal and on all movements of each animal in an official database. Such systems provide full and quick traceability of any animal in the country. Often manual on-farm registers containing all information on births and movements supplement the registration in databases. In EU countries, BSE gave rise to very strict regulations on traceability of cattle.
Theoretically, traceability is possible through manual on-farm registers. However, there is no information control to make sure that information from one on farm register matches information from the register of the next farm. Therefore the traces are easily broken, and no one will know about it until the day when there is a need to trace animals. Even without broken traces it takes a very long time to control traceability through manual on-farm registers.

Cattle Registration

Movement in official database	Movement at sale yard or auction mart database	Animal and movement in official database	Herdbook animal in herdbook database	Manual farm registers		Governmental requirements on movements	Governmental requirements on animals and movements	No governmental requirements
38 %	15 %	77 %	49 %	49 %		0 %	80 %	3 %

Computerised databases with mandatory frequent reporting from all animal holders are able to discover any discrepancy in traceability information by comparing information from buyer and seller, even trader or transporter. The database can immediately detect if a trace is broken, and measures to correct the errors can be initiated before a critical situation arises during a trace-back operation.

Traceability information of cattle

Place of origin	Date of birth	Breed	Sex	Mother	Father	Placement date	Previous farm	Outgoing/sale date	Next farm	Other
82 %	90 %	82 %	84 %	79 %	45 %	92 %	76 %	87 %	66 %	18 %

Other: veterinary information, culling reason, colour etc.

Sheep systems

Much of the basics of I&R systems are similar across species, so there will be less comments on sheep and goat systems than on cattle systems in this paper. However, in some developing countries the importance of sheep and goats may be higher than in most of the countries that filled in the questionnaire.

Description of sheep system	Percent of answers
Mandatory permanent ID-system for all animals, unequivocal lifetime ID	57
Mandatory permanent ID-system for herdbook animals, unequivocal lifetime ID	32
Mandatory permanent ID-system for disease control, unequivocal lifetime ID	7
Mandatory temporary ID-systems (movement tags)	4
Voluntary ID-systems for herdbook animals, unequivocal lifetime ID	0

Description of sheep system	Percent of answers
Governmental mandatory ID-system at animal level, no official database	11
Governmental mandatory ID-system and database at animal level	61
Governmental mandatory ID-system at group level, no official database	11
Governmental mandatory ID-system at group level and database	14
No governmental requirements	4

In 25 % of the reported systems flock registration was used instead of individual registration. Still in 96 % of the reported systems the animals have unequivocal lifetime IDs.
The time of tagging varies considerably more among sheep than cattle. This may be due to different management systems, different environments, etc.

Time of tagging of sheep	Percent of answers
Within seven days from birth	39
Within 20 days from birth	12
Within 30 days from birth	8
Within 60 days from birth	15
Within 180 days from birth	8
Before leaving place of birth	15
Temporary tagging at each movement	4

Purely serial ID codes are less frequent in sheep, whereas it is more frequent that information on farm is included.

ID codes for sheep

Visual ID numeric	Visual ID alphanumeric	Check-digit in visual ID	Visual ID purely serial	Visual ID contain region	Visual ID contain farm	Visual ID contain organisation	Visual ID unique, country	Visual ID unique, farm	Visual ID unique, organisation
79 %	21 %	Yes: 11 % No: 29 %	21 %	43 %	43 %	18 %	75 %	14 %	7 %

EID in connection with sheep

EID approved	EID in eartag	EID in attachment to eartag	EID in bolus	EID in implant
Yes: 30 % No: 70 %	10 %	10 %	10 %	0 %

Sheep registration

Movement in official database	Movement at sale yard or auction mart database	Animal and movement in official database	Herdbook animal in herdbook database	Manual farm registers		Governmental requirements on movements	Governmental requirements on animals and movements	No governmental requirements
25 %	0 %	39 %	39 %	57 %		18 %	46 %	11 %

The use of computerised databases is much lower even in connection with registration of flock movements. The traceability of cattle is better than the one of sheep.
Lower traceability of sheep and goats may also affect other species. In case of infectious diseases such as Foot and Mouth Disease the high traceability of cattle may be jeopardised by insufficient traceability of sheep, goats, pigs and other cloven-footed animals.

Traceability information in sheep

Place of origin	Date of birth	Breed	Sex	Mother	Father	Placement date	Previuos farm	Outgoing date	Next farm	Other
88 %	83 %	79 %	79 %	71 %	63 %	92 %	79 %	92 %	83 %	17 %

Goat systems

The goat systems hardly differ from the sheep systems reported. Please refer to the comments on sheep systems.

Description of goat system	Percent of answers
Mandatory permanent ID-system for all animals, unequivocal lifetime ID	58
Mandatory permanent ID-system for herdbook animals, unequivocal lifetime ID	31
Mandatory permanent ID-system for disease control, unequivocal lifetime ID	8
Mandatory temporary ID-systems (movement tags)	4
Voluntary ID-systems for herdbook animals, unequivocal lifetime ID	0

Description of goat system	Percent of answers
Governmental mandatory ID-system at animal level, no official database	12
Governmental mandatory ID-system and database at animal level	54
Governmental mandatory ID-system at group level, no official database	12
Governmental mandatory ID-system at group level and database	15
No governmental requirements	8

Time of tagging of goats	Percent of answers
Within seven days from birth	46
Within 20 days from birth	13
Within 30 days from birth	4
Within 60 days from birth	8
Within 180 days from birth	13
Before leaving place of birth	13
Temporary tagging at each movement	4

ID codes for goat

Visual ID numeric	Visual ID alphanumeric	Check-digit in visual ID	Visual ID purely serial	Visual ID contains region	Visual ID contains farm	Visual ID contains organisation	Visual ID unique, country	Visual ID unique, farm	Visual ID unique, organisation
85 %	15 %	Yes: 15 % No: 31 %	23 %	42 %	39 %	12 %	77 %	15 %	8 %

EID in goat

EID approved	EID in eartag	EID in attachment to eartag	EID in bolus	EID in implant
Yes: 35 % No: 65 %	12 %	12 %	12 %	0 %

Registration in goat

Movement in official database	Movement at sale yard or auction mart database	Animal and movement in official database	Herdbook animal in herdbook database	Manual farm registers		Governmental requirements on movements	Governmental requirements on animals and movements	No governmental requirements
19 %	0 %	35 %	39 %	54 %		15 %	42 %	19 %

Traceability information in goat

Place of origin	Date of birth	Breed	Sex	Mother	Father	Placement date	Previuos farm	Outgoing date	Next farm	Other
90 %	81 %	76 %	76 %	71 %	62 %	91 %	81 %	91 %	81 %	14 %

Diversity of animal identification techniques: from 'fire age' to 'electronic age'

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Abstract

Animal marking is associated to the domestication of different animal species by humans for various reasons. Identification techniques are classified according to characters used and to their permanence on the animal. Main artificial permanent systems are branding (hot-iron and freezing), tattooing, ear notching, ear tagging (metal and plastic) and electronic identification (injectable, ear tags and bolus), but natural systems are also used (mainly retinal imaging and molecular markers). Recently artificial systems and natural systems have been combined as a way to provide a real time tagging and tracing-back methodology for on farm use and administrative purposes until slaughtering, and as a method to audit the tracing-back of animals, carcasses and meat cuts in the food chain.

Keywords: tagging, marking, branding, tattooing, ear tags, electronic identification, transponders.

Introduction

Animals marks have been used by herders since the Neolithic period and are strongly associated to the domestication of animals (Landais, 2001). Different methods of marking animals were used by Egyptians, Greeks, Romans, nomadic people of Scandinavia, Asia and Africa, and pre-Hispanic Americans for different purposes.

Animal identification methods could be classified according to the nature of the characters used (natural or artificial), and to the permanence of the character on the animal (permanent or temporary). Natural characters (e.g. coat color, horns, hair curls, fingerprinting) are generally used for animal recognition, while artificial characters (marks) are made by humans for different purposes. Permanent marks (indelible), are applied as signs of individual identification, ownership or protection (e.g. animals in quarantine); and, temporary marks (e.g. erasable or removable) are useful for animal management.

Many identification techniques are possible in practice due to the large diversity of domestic animal species, breeds, productive purposes, exploitation systems and environmental conditions, Moreover, the large number of identification methods and devices currently used clearly indicates that not one is fully satisfactory. Retention rate values of 95% (two years) to 98% (one year) and 85% readability are considered acceptable in many cases (Stanford *et al*., 2001; ICAR, 2003) but are not fully achieved. Available methods for animal identification have suffered dramatic changes in the last decades, but surprisingly, old and new techniques coexist in most countries.

The global trade of live animals or animal products, has dramatically increased the risks of human and animal disease outbreaks and makes difficult the traceability in the food and feed chains. The European 'White paper on food safety' published in 1999, places traceability as the backbone of all policies concerning food safety. Exporting countries need to be prepared to meet the new traceability requirements of importing countries, and this gives added impetus to animal identification methods which have not been sufficiently supported before such us herd management and improvement, quality monitoring of livestock products, and welfare or health control requirements.

Current animal traceability requires, at least, the use of a unique and individual identity code for each animal, and a transparent, credible and verifiable system to assure identity (McKean, 2001). Two recent European regulations for the identification and registration of cattle and beef (CE 1760/2000) and sheep and goat (CE 21/2004) have specified the identification requirements for animals and meat interchanges in the European Union. Standardized ear tags are currently the approved identification device for cattle (from January 1 of 1998), sheep and goat (from July 9 of 2005), but logistic problems (nearly 300 million of animals in the EU) make the use of electronic identification for automatic animal recording and data management recommendable. For this reason, a decision will be taken in 2006 to make mandatory (from January 1 of 2008), in sheep and goat EU countries with more than 600 000 animals, the use of electronic identification of these species. Moreover, the extension of the electronic identification as an official identification system for cattle in the European Union is also now under study.

Identification techniques

Animal identification methods in history were reviewed by Sánchez Belda (1981) and more recently by Blancou (2001) and Landais (2001), distinguishing between permanent and non permanent systems. Reasons for using a particular identification system vary in history according to the cultural and economical conditions of human societies. Currently, the main reasons for using an animal identification system in the modern livestock industry are:

- to **indicate property ownership, for which** registered brand or marks is used. Permanent marks are the only identification system acceptable by law as a legal proof of identity and ownership.
- to **identify individual animals, as** a prerequisite for individual performance recording in improved breeding and management systems. Temporary systems may also be used as auxiliary for this purpose.
- to allow a mechanism for **disease and residue traceback** to the property of origin. Permanent marks are again the only acceptable identification system for this purpose.

Main systems used for permanent animal identification in the current livestock industry include:

1) branding (by fire or freezing), ear marking (by notching, tattooing and ear tagging);
2) electronic identification (injectable, ear tag, and bolus), and
3) natural characters (DNA genotyping and retinal images); and are here reviewed and compared.

Traditional identification techniques

Hot iron branding

Hot iron branding causes a scar where the hair regrows in a different pattern than on the surrounding skin. Branding of cattle, horses, mules, and buffalo is traditionally done by using a hot iron. Sheep and goat were also branded in the past (normally on the nose or cheek), but less frequently than in cattle or horses. This ancient method of marking is forbidden in countries with advanced animal welfare laws (DEFRA, 2003), but is still an official sign of ownership in many countries where books of marks are currently operative for cattle and horses. More humane options for marking animals are readily available and this method should only be used when other methods are not possible.

A single letter, numbers, simple figures or bars are normally not accepted as ownership branding marks for most livestock, but more than three letters is not recommended (NDA, 1966). Different types of irons are used, from the most simple (bars, letters or single numbers from 0 to 8) to the most elaborated (forged symbol of the owner) and uses include identification of property (e.g. owner initials or symbol) and individual marks (e.g. year of birth and serial number). When composed letter or numbers are branded, separate irons for each character are preferred and a distance of 10-12 cm must be maintained. Branding irons are usually made of mild steel alloys, which are generally better heat conductors than mild steel. The surface of the branding iron should be flat, smooth, and no more than 4 mm wide, and an iron handle of 45-60 cm long is also recommended.

Calves and foals are usually branded before weaning when they are 3-5 months old. At this age the hide is thick and the animals are easier to handle or restrain. A calf-marking cradle may be used for easier and safer restrain during branding (Figure 1). If animals are branded when they are too young, the brand grows with the hide and will greatly reduce hide value at an adult age.

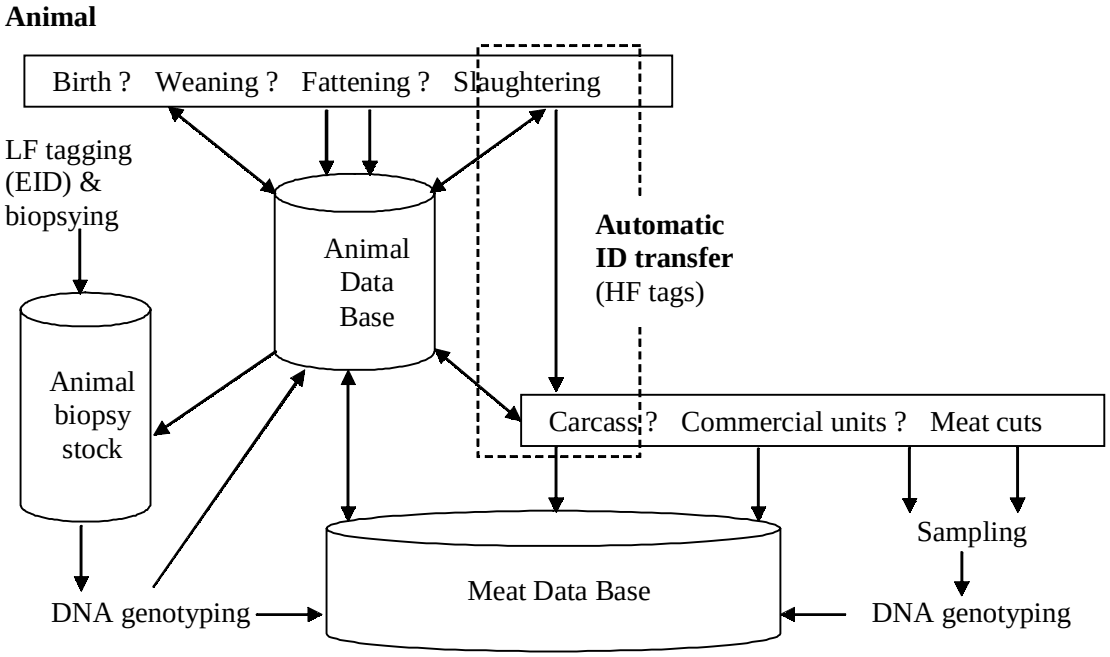

Figure 1. Combining electronic identification (EID) and DNA fingerprinting for traceability of animals and meat in the meat chain: Information flow.

Iron application should be performed when iron is hot-white or ash-grey colored and not exerting excessive pressure, allowing the iron to do the branding. Recommended procedure (Hurst and Irwin, 2000) is to put the iron against the animal's skin for 5-6 s (3 counts), without pressure, and roll the iron with the shape of the animal's body to apply the same pressure at all points of iron contact. Long application, overheating, rough use or damage to the branding surface of the iron will cause incorrect brands. Thereafter, cold water or wound oil should be sprayed on the mark to reduce burning effects and to improve healing. For long-coated cattle, the branding area should first be clipped.

The adequate method of heating the irons is a fire of wood or bark burned to coals. Gas burners for heating brands are easily portable and more convenient than traditional wood fires. Coal or coke must never be used, as they burn at too hot a temperature. Electrically heated branders are also available in the market. The correct heat for branding is a blue flame that will instantly burn a piece of paper or board. If the heated iron shows any red, it is too hot. When branding is finished, the hot irons should be cleaned and submerged in sump oil to cool and protect from oxidation. Fire branding should never be performed in rainy weather, or

on hides that are wet, because the hot iron boils any moisture in the coat and scalds the surrounding area. Unnecessary pain to the animal and no regular in shape brands will be caused in these conditions.
Location of the brand on the animal body is chosen for visibility (flank, rump) but alternative locations (cheek, hind limb) are currently recommended to avoid hide depreciation. Light branding (Landais, 2001) or hoof branding (in horses; Sanchez Belda, 1981) are also used for temporary marking of animals intended for sale. In this case the hot iron is lightly and briefly applied to the animal, aiming to burn the coat but not the skin. Branded animals should not be sold for slaughter within 3 weeks of the operation. If sold within the 3 weeks, the purchaser should to be informed in writing.
Nevertheless, hide is a co-product of the cattle meat industry and in most countries the hide makes up 10-15% of the total value of the animal. It is estimated that branding reduces hide values by $10-20 per hide. A brand placed in the correct position (left rump) results in minimum trimming when the hide is processed by the leather industry.

Caustic branding

Caustic chemicals (corrosive acids, caustic soda paste, caustic potash) were proposed as an alternative to hot iron for branding in cattle. Although not using fire is a great advantage in practice, caustic branding is difficult to apply with accuracy and gives irregular results. Moreover, according to the new welfare regulations in many countries (DEFRA, 2003), it is a painful and not recommendable identification method and it should not be used to brand animals.

Freeze branding

A freeze brand may replace an iron brand in dark coated animals, as initially used in dairy cows and most recently also in horses and mules. Advantages of freeze branding, when compared to hot iron branding, are less discomfort and reaction from the animal. Freeze branding is less damaging for hide than fire branding if the application period is adequate, and no weakness occurs in the leather. Disadvantages of freeze branding are that it is more expensive and time consuming than fire branding, the final brand takes up to 4 months and the technique is less suited to light-colored stock. Moreover, freeze brands may be temporary tinted for fraud. Nevertheless, freeze branding is accepted as a reasonable identification method in most of cases (DEFRA, 2003).
The main effect of freeze branding is to destroy the cells that produce the pigment in the skin and hair (melanocytes). After the skin is exposed to the chilled branding iron, it is frozen in the shape of the brand applied and within 2-3 min the skin thaws and the area reddens. A marked edema with fluid-filled swelling develops 5-10 min after brand application, and persists for approximately one day, depending on the exposure time. The edema then recede, and the branded area becomes dry and scurfy. Varying amounts of skin and hair are lost over the next 2-3 weeks. These areas are generally legible until white hair growth

becomes evident. Overexposure to the freeze brand may result in excessive hair follicle loss in the centre of the brand, and consequently the growth of white hair will occur only on the edges of the brand site. Subsequent hair growth occurs usually 6-10 weeks after branding, depending on the season. Freeze branding produces a permanent mark on the skin, the hair re-growing in a lighter colour and the skin itself lacking in pigments. The resulting brand, if adequate, is legible from about 30 m. In the case of white and grey horses a bald area is frequently observed after freeze branding.

Although liquid N was used initially, it is expensive and more care is needed by the operator. The temperature of liquid N is lower, and the application timing is much more critical in order to avoid overfreezing the brand. Moreover, it can only be transported in suitable thermos with vented tops. Dry-ice made directly from a CO_2 cylinder or dry ice-methyl alcohol mixtures are more currently used than liquid N. For application, clipping the brand site as close to the skin as possible and removing loose hair and dirt, which increases time and preparation requirements is recommended. Soaking the brand site with methylated spirits immediately before applying the brand, and repeating for each character improve the brand. The brands moulds are cold enough when bubbling (boiling) stops and application on the hide for approximately 15-40 s depending on freezing solution and age of the animal (Table 1). Restraint of the animal is essential. Animals in poor condition do not brand as well as those in moderate to good condition. The branding of calves (under 4 months) is not recommended.

Freeze branding irons should be made of copper or bronze alloy. Solid copper is the best but it is most expensive. Conventional steel irons work but are more likely to result in a poor unreadable brand. The face of the irons should be rounded to uniformly transfer the cold from the iron to the skin. Suggested dimensions for the branding face are 6-10 mm wide, 70-100 mm high and 38-50 mm deep. Handles should be about 380 mm long. Approximately 7 kg CO_2 will produce enough dry-ice to fill

Table 1. Freeze-branding time for legible brands in cattle and horse.

Animal specie and age	Freezing solution	
	Dry ice (–70°C)	Liquid nitrogen (–197°C)
Cattle:		
Calves 4 to 8 months	25 s	15 s
Yearlings	25-30 s	20-25 s
Adults	35-40 s	25-30 s
Horse:		
Foals	-	6-12 s
Adults	-	8-12 s

approximately 100 digit molds. A mixture of 5 kg dry-ice to 9 l of methylated alcohol is enough for 150 animals to be branded with three characters each. On animals with light-colored coats, a bare (hairless) brand can be made by holding the iron on for 50-60 s, which is longer than is necessary when applying a brand to a dark-coated animal. The brand must remain in the cooler for 60–90 seconds after each use. Branding time should be increased on dark coats and thicker hides. Care should be taken when handling freeze-branding coolers because they can produce frostbite in the human skin.
A new freeze branding system is also available for cattle and horses based on digit moulds which are filled with dry ice on the site by using a special gun and a liquid-withdrawal tank of CO_2. Recommended times for branding are longer (horses, 2 0s; dairy cattle, 60 s; and, beef cattle, 90 s). Branding with this system is more easy and accurate.

Paint branding

Sheep branding is usually done by painting the wool after shearing with the symbol of the owner or with digit moulds similar to those used for freeze branding. As this mark is temporary, a second system (ear notching, tattooing, ear tags, etc..) needs to be used for a permanent indication of ownership. Paint is also used for short term marking of other livestock species (cattle, pigs,...). With this aim sprays of biocompatible paints and wax colored sticks are used.
Life of paint branding is long in fine wool sheep breeds, but it is short and unsatisfactory in coarse wool breeds. Same problem is observed in hairy lambs.
Paint must be washable to avoid wool depreciation. Colors commercially available are usually yellow, blue, green, black, red, or purple. Brands are usually painted for the side, hip, nose, or jaw on either the left or right side of sheep. No owner brand should be recorded across the back of a sheep, which are normally reserved for individual sheep numbers in most countries.

Ear notching

Ear notching is a very old practice in cattle, sheep, goat and pig, as a chip and permanent system to indicate ownership. They are made by knife cutting or by using special cutting pliers. Old Spanish flock books (De la Maza, 17XX) included detailed information on paint branding and ear notching of sheep.
Ear notching is worldwide used for holding identification and in some cases as a cheap system for numbering. Moreover, tuberculosis positive cattle was marked in the past with a T notch in the ear to identify animals to be slaughtered. Ear wound necrosis and breakage, as well as development of fly worms on the wounds may alter the notch codes.
A mathematically interesting system of numbering based in ear notches is still being used in pigs (Official Berkshire Ear-Notching System). In this system (Figure 2), a smart combination of notches in the right ear (coded as numbers 1, 3, 9, 27 and 81) and in the left ear (coded as numbers

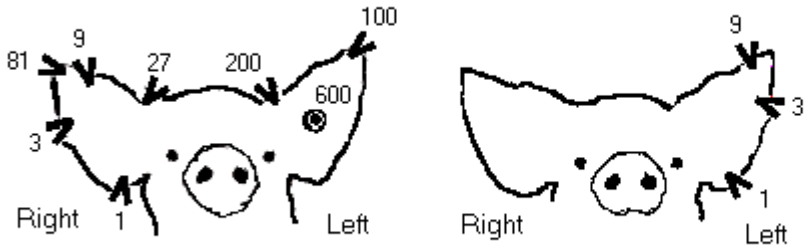

Figure 2. A mathematically interesting system of numbering based in ear notches is still being used in pigs (Official Berkshire Ear-Notching System).

100, 200 and 600), are used for litter marking. Up to 1 199 litters can be marked with this coding system. Right ear is also used to add the individual marking of a pig inside a litter (coded as digits 1, 3 and 9). Each pig in a litter will have the same notches in the right ear and different notches in the left ear.

Tattooing

Ear tattooing is one of the best conventional methods of permanently identifying animals. The number code that is applied will be in most cases permanent throughout the animal's life. Tattoos are usually applied on either the left or right ears (all species), lip (horses), groin (pets) and under the tail (sheep and goat). Since the tattoo can only be read when the animal's head is restrained, it should be used in conjunction with another system which allows the animal to be identified in the paddock. Black dye paste is normally used for tattoos, but green dyes are preferred with dark or black-eared breeds. The use of a back light may also help to read tattoos in animals with dark skin.

Tattooing should be done with restrained animals in an skin area which is free of hair, cartilaginous ridges and large veins. Tattoos in the top half of the ear retain their clarity better than those in the bottom half. Although ear is the most common place for tattoos, horses were widely tattooed in lower lip in the army and in many purebreds. For dairy sheep and goat the base of the tail was also commonly used. In both cases it is recommendable to tattoo the numbers towards down for easy reading. Tattooing hammers with big numbers were also used for tattooing the holding numbers in pig expedition, although this practice is not recommended currently because is increasing pig stress at transportation to slaughtering.

For better tattooing, skin should be cleaned and wax in excess removed by using alcohol. After cleaning and applying the dying paste on the area to be tattooed, the tattooing pliers should be applied firmly and

quickly, making sure the digits are the right way up for reading. Thereafter, he tattooing paste should be rubbed strongly into the punctures.
Brass digit plates with nickel plated steel needles punch out clean and clear tattoos. Commercially available digits for tattooing range between 5 and 20 mm high. The minimum ear tattoo size for lambs, kids and piglets is 10 mm; for calves, sheep, goat and pigs is 15 mm, and larger numerals should be used for adult cattle. Two sets of numerals are necessary if both young and adults are to be tattooed in a farm. Rotary 4-chain tattoo devices are also available for marking large number of animals. Carefully disinfection of the tattooing digits is recommended to avoid infections and diseases transmission. Moreover, frequent ear tissue necrosis or fly worm attacks are described after ear tattooing in subtropical conditions (Garín *et al.*, 2003).

Conventional ear tags

Ear tags are currently the most common method of identifying individual animals in practice. They can be done in a great variety of shapes (flag, button, loop, etc…), materials (metal and plastic), sizes and colors. Only tamper-proof and non reusable ear tags should be considered as a permanent means of identification. Ear tags are easier to read if numbered with the same numbers on both sides, which is recommended for practice. Retention rate of ear tags is extremely variable ranging from 60-98% depending on tag features, species, breeds and environmental conditions. Nevertheless, little information is available in scientific literature and biocompatibility of most materials is questioned. Animal welfare in regard to ear tags is also questioned in some breeds and conditions.
Resistance to environmental conditions and biocompatibility are critical features for choosing the materials used in ear tags. The placement site is specific for each type of tags and critical for its permanency on the animal. Moreover, environmental conditions affect infection rate of newly applied ear tags, and no ear tagging is recommended with very hot temperatures or during fly activity season. It is advisable to perforate the ear one or two weeks before application in order to reduce the risk of infection of the tagging site. Dipping tags in an antiseptic solution before application is a controversial practice but it is thought that it helps to improve retention and to reduce the risk of infection of ear tags.

Metal tags

Metal loop ear tags are made in brass or aluminum. Brass ear tags with tamperproof closing system have been commonly used for cattle tuberculosis and brucellosis control in many countries. Small aluminum loop tags are easy to stamp and to apply, but also easier to remove. Both metal era tags should be placed in the top of the ear, with an overhang of 5-8 mm, and within the inner half of the ear. Placing the tag in the inner portion of the ear means that they are less likely to be torn out.
These tags are very difficult to read unless the animal is firmly restrained but their loss rate is normally very low in most farming conditions.

Small metal ear tags called 'self-piercing' (applied without pliers) have been very used as short term identification devices in the past, but are not currently recommendable because they are easily removed.

Flexible plastic tags

Plastic ear tags are currently the most common method of identifying individual animals in many countries, and when they are well designed and adapted for the animal specie and breed, they are a recommendable option for livestock identification. They are ideal as a management tool but only tamper-proof and no reusable ear tags should be considered for permanent identification.

With developments in plastic industry, plastic ear tags have improved considerably, with free-swinging, soft, self-piercing multicolored types available. Among the different variety of shapes, sizes and colors available, only soft polyurethane ear tags are currently recommendable for greater retention on the animal. Improved metal or hard plastic points for the ear tag pins are also recommended. Plastic ear tags are available pre-numbered or plain. Specific numbers can be mechanically recorded or hand written on the plain tags by using special markers. Laser recording or the use of fluid plastic is recommendable for the permanent recording of plastic ear tags. Addition of bar codes in ear tags is a useful tool for automatic reading and code recording, but the utility of this method is restricted to new ear tags. Less than 20% of bar coded ear tags were successfully read in feedlot calves by Ghirardi *et al.* approximately 6 months after application.

A study of ear structure shows that the ear cartilage is separated by two prominent structures running parallel to each other. It is important for the plastic ear tag be placed in a central position between these ridges, in the proximal half of the ear, and in a place clear of hair. Specific and well designed pliers need to be used at application.

Electronic identification

Electronic animal identification is currently based on the use of radio frequency waves in the low frequency band. This allows the animal tissues to be penetrated with few radiating effects. The EID device is called 'transponder' (from the words transmitter and responder) and passive technology (without batteries) is used in practice.

The passive transponder is a miniaturized electronic radio-frequency device consisting of an integrated circuit (microchip) and an antenna, which is all enclosed in a water-proof protector. The transponder is activated by a signal transmitted by a readout unit called 'transceiver' (from the words transmitter and receiver). The transponder reacts to this signal by emitting an 'information telegram' previously recorded in its memory. Communication between transponder and transceiver can be made by using alternative (half-duplex, HDX) or simultaneous (full-duplex, FDX) transmission. With HDX, the transponder includes a

capacitor for increasing energy storage during activation. After transmission of the information telegram and discharge of stored energy, the transponder is dormant until the next activation cycle.

The information telegram is a digital string in which the bits are partitioned in functional segments corresponding to: header, ID code, cyclic redundancy check error detector, trailer and control. An ISO standard (ISO 11784) was approved in 1996 for the ID code of read only (R/O) transponders intended for animal ID. The standardized ID code is a unique 64 bit combination, in which 10 bits correspond to the country code (translatable to a 4 digit number according to ISO 3166 standard) and 38 bits to the animal ID code (translatable to a 12 digit number); the rest (16 bits) are for reserve. Nearly 275,000 million (2^{38}) different ID codes can be programmed according to this standard. A discretional use of 8 bits from the reserve, linked to the country code, for a re-tagging counter (3 bits) and an animal specie indicator (5 bits) were authorized in 2004. The country code can be replaced by a 3 digit manufacturer code given by the ICAR (International Committee for Animal Recording). The ISO 11785 standard on technical concepts of EID for animal ID, also approved in 1996, recognizes the HDX and the FDX-variant B methodologies for the interchange of information and states the characteristics of transponders and transceivers for a full reading compatibility. Thus, activation frequency was standardized to 134.2 kHz and the length of the transponders information telegram varies according the technology (HDX, 112 bits; and, FDX, 128 bits). A list of manufacturer codes and current ISO complying ID devices is available on the web (*www.icar.org/animal.htm*). Three main types of transponders for animal ID are recognized by ICAR (2003) and are:

- Injectable transponders: For all animal species. The transponders are covered by a bio-compatible glass capsule and are implantable through a needle. They are injected subcutaneously in different body sites.
- Electronic ear-tags: For almost all livestock species. Transponders are included in a plastic round button-tag and used as the female of a conventional plastic ear-tag.
- Bolus transponders: For ruminants only. Transponders are placed into a high specific gravity capsule (bolus) and orally applied to ruminants. They are retained in the fore-stomachs, mainly in the reticulum.

ICAR (2003) also suggests a minimum retention rate of 98% to approve their use as official ID devices in animals.

Since the first international symposium organized by the General Directorate of Agriculture of the European Commission in 1990 (Lambooij, 1991), significant research has been done in Europe on the use of different types of transponders for animal ID. Previous research projects on EID of farm animals granted by the European Commission are: FEOGA CCAM-93-342 (1993-94; Caja *et al*., 1994), AIR3-2304 (1995-97; Geers *et al*., 1998) and the large scale implementation IDEA project conducted in 6 countries (France, Germany, Italy, Netherlands,

Portugal and Spain) on nearly 1 million animals (1998-2001; Ribó *et al*., 2001). Moreover, several projects complemented the IDEA results in cattle (Fallon *et al*., 2002) and goats (Pinna *et al*., 2003).
Many results related to the use of injectable transponders in ruminants (Caja *et al*., 1998; Lamboij *et al*., 1999; Klindworth *et al*., 1999; Conill *et al*., 2000, 2002) and boluses (Caja *et al*., 1999; Lamboij *et al*., 1999; Fallon, 2001; Garín *et al*., 2003) have already been published, but only preliminary or partial results have been published so far on the IDEA Project (Ribó *et al*., 2001; San Miguel *et al*., 2004). The final report of the IDEA project is currently available on the web (*www.idea.jrc.it/pages%20idea/final%20report.htm*).
Conclusions of the projects showed that efficiency of EID vary with type and brand of the ID device, but efficiency is greater than with conventional tagging systems (metal or plastic ear tags, collars and tattoos) and above the ICAR recommendation (>98%) when certified devices are used. Subcutaneously injected transponders are currently not recommended in ruminants because of the recovery difficulties and risks to the food chain. There is little information on the efficiency of conventional and electronic ear tags in ruminants and results have shown a wide range of variation in losses (2-48%; Conill *et al*., 2000, 2002; Curtis, 2002).
Despite the importance of pigs for the meat industry, few and contradictory results are available on the use of injectable transponders (Lamboij *et al*., 1992, 1995; Stärk *et al*., 1998) and electronic ear tags in swine (Stärk *et al*., 1998; Caja *et al*., 2000; Babot *et al*., 2004), indicating the need for new approaches in the use of EID in pigs. The most important research is focused on determining the optimum injection site to warrant the full recovery of transponders in the abattoir, and intraperitoneal injection may well be an interesting option in practice (Caja *et al*., 2000; Babot *et al*., personal communication; Hernández-Jover *et al*., personal communication).

Natural characters identification

Body marks and silhouette identification

Coat and silhouette patterns (spot description) as well as hair details were widely used for horse and cattle identification in the past.
Most recently, Holstein dairy cattle required a photography for the inscription of a cow in the breed's herd book. Digital pictures made this task easier and some stood book and herd books include pictures of the animals in their data base. Nevertheless, coat features are not a useful tool for individual identification in breeds uniformly coated.

Optical identification

Retinal imaging and iris imaging are the current methods used for animal optical identification in practice. Retinal imaging uses the patterns of the retinal blood vessels to produce a unique image of each eye. The vascular eye pattern is unique between twins, clones and even between eyes of the same animal, and collection of retinal data on the slaughter line is also possible. Retinal imaging is preferred in practice because it is

more appropriate than iris imaging because the iris changes through animal life (Golden, 1998). In addition, images of the iris can be difficult to acquire when corneal diseases occur. It is a non-invasive method in which, after immobilization of the head, a photo of the retinal vascular pattern is obtained through the pupil, in only a few seconds, by using a digital camera. Retinal images are easy to obtain, reliable and low cost. Depending on the animal behavior and the farm restraining facilities, images can be collected directly in pens or in a immobilization chute. Images can also be collected while vaccinations or other examinations are given. In slaughterhouses the system is installed in the slaughtering line, prior to head removal, providing the tracking link between the animal and the carcass.

The cost of taking several images per animal is less than the current cost for one electronic ear tag. Moreover it is a competitive system when compared with other available identification and data collection systems. A tamper-proof system has also been developed by Golden (1998) combining encrypted geopositional and time signals with retinal images. Auxiliary data collection equipment (weighing scales, barcode and electronic identification readers, etc...) can also be connected to the optical imaging device.

Fingerprinting

Different types of body marks have been used for livestock fingerprinting according to the specie characteristics. Only nose prints are still being used currently in

Molecular markers

The use of DNA genetic markers as a tool for individual ID is today a well established methodology in human, plant and animal sciences. Genetic fingerprinting relies on the detection and analysis of DNA polymorphisms (changes in the DNA sequence) that can be found in the genome. Each polymorphic region analyzed can be used as a 'genetic marker' to differentiate between individuals, and the combined profile of a set of informative markers allows individual ID (except for monozygous twins that are genetically identical).

The DNA can be extracted and the changes in the sequence analyzed using the 'polymerase chain reaction' (PCR) from a single cell. The choice of the markers must take into account the sample type, the conservation procedure and the cost of the analysis.

Different markers can be used to obtain DNA fingerprints, but due to their abundance and high informativity (degree of polymorphism) microsatellites are the markers commonly used for genetic ID in domestic animals (Cunningham and Meghen, 2001). Microsatellites or 'short tandem repeats' (STR) consist of repeats of a simple sequence of 2 to 5 DNA nucleotides. At any one DNA site (locus), there are usually several different alleles in a population, each identifiable according to the number of repeated units. These alleles can be detected by using 'primers' designed from the unique sequence that is located on either side of the microsatellite.

More than 2,000 microsatellites are currently characterized and located in the genetic map of farm animals as published on the web (*www.thearkdb.org*).
The ISAG (International Society of Animal Genetics) has selected a standardized set of microsatellites to be used in the bovine and porcine DNA laboratory comparison tests. A simulation study has shown that a subset of 8 or more microsatellites are enough to achieve individual ID in cattle whatever the population structure of the sampled individuals (Arana *et al.*, 2002). Thus, DNA profiling, through the use of a selected subset of microsatellites, can confirm the ID of two specimens at probability levels up to 99.9% and can be used for the verification process and random auditing of the traceability of animals and meat.
The difficulty to fully automate microsatellite genotyping for high throughput analysis of samples has revived interest in new types of genetic markers. The 'single nucleotide polymorphisms' (SNP) are DNA polymorphisms due to single nucleotide substitutions or insertions / deletions. The SNP are biallelic markers and their informativity is consequently lower than microsatellites. However, as a result of their abundance in the genome and simplicity of analysis, they are an interesting alternative for individual ID. SNP with intermediate frequencies are the most useful and a quantity from 30 to 50 will probably be necessary for livestock ID (Heaton *et al.*, 2002; Gut *et al.*, unpublished).
Genetic traceability of meat using microsatellites has already been demonstrated in beef samples (Meghen *et al.*, 1998; San Cristobal-Gaudy *et al.*, 2000; Shackell *et al.*, 2001) as DNA can be easily recovered from a biological sample at each step of the production chain, including cured or cooked meals (Meyer *et al.*, 1994; Wang *et al.*, 2000).

Traceability of livestock and meat by using EID and DNA: 'EID+DNA tracing' European project

Combining EID and DNA fingerprinting for traceability, as proposed by Caja (1998), can consequently be used in the meat chain where biological samples from animals can be used to check the ID of carcasses or meat. The EID provides a real time tagging and tracing-back methodology for on farm use and administrative purposes until slaughtering, and the DNA profile is the method to audit the tracing-back of the ID of animals, carcasses and meat cuts.
With this aim, a research and implementation project was designed and granted in the EU FAIR 5th called 'EID+DNA Tracing' (Reference: QLK1-CT-2001-02229) Detailed information on the project is available on the web (*www.uab.es/tracing*). The project involves 10 partners from 5 EU countries (Germany, Italy, France, Spain and United Kingdom) for 3 years.
The first part of the project is related to the study of animal EID by using bolus (ruminants) and injectable (pigs) ISO complying transponders. An automatic system for the transfer of the animal ID to the carcass based on the use of flexible radio frequency label transponders at high frequency (13.56 MHz) currently used for item management, is being implemented. The project also includes the development of new equipment for on farm

Table 2. Performance comparison of different livestock identification systems on farm conditions.

Identification system	On farm traits						
	Species and breeds	Animal welfare	Cost of devices	Expertise required	Lifespan retention	Reading ability	Tamper-proof
Branding:							
Hot	All	Low	Cheap	Medium	Long	Medium	Yes
Caustic	Some	Low	Cheap	Low	Long	Medium	Yes
Freezing	Some	Medium	Medium	Medium	Long	Easy	No
Paint	Some	Good	Cheap	Low	Short	Easy	No
Ear notching	All	Low	Cheap	Low	Long	Medium	No
Tattooing	All	Medium	Cheap	Medium	Long	Medium	No
Ear tagging:							
Metal	All	Medium	Cheap	Low	Medium	Medium	No
Plastic	All	Medium	Medium	Low	Medium	Medium	No
Electronic:							
Injects	All	Medium	Expensive	High	Long	Easy	Yes
Ear tags	All	Medium	Expensive	Low	Medium	Easy	No
Bolus	Some	Good	Expensive	Medium	Long	Easy	Yes
Imaging:							
Pictures	Some	Good	Medium	Low	Long	Easy	Yes
Iris	All	Good	Medium	High	Medium	Medium	Yes
Retinal	All	Good	Medium	High	Long	Medium	Yes
Fingerprinting:							
Body marks	Some	Good	Cheap	Medium	Long	Easy	Yes
DNA	All	Good	Expensive	High	Long	Difficult	Yes

Table 3. Performance comparison of different livestock identification systems on slaughterhouse conditions.

Identification system	Slaughterhouse traits						
	Official use	Process automation	Reading ability	On line retention	On line recovery	Carcass retagging	Individual traceability
Branding:							
Hot	Yes	No	Medium	No	No	Yes	Poor
Caustic	No	No	Medium	No	No	Yes	Poor
Freezing	Yes	No	Easy	No	No	Yes	Poor
Paint	Yes	No	Easy	No	No	Yes	No
Ear notching	Yes	No	Medium	Medium	No	Yes	Poor
Tattooing	Yes	No	Medium	Medium	No	Yes	Medium
Ear tagging:							
Metal	Yes	No	Medium	Low	Easy	Yes	Medium
Plastic	Yes	Medium	Medium	Low	Easy	Yes	Medium
Electronic:							
Injects	Yes	Yes	Easy	High	Difficult	Yes	High
Ear tags	Yes	Yes	Easy	Low	Easy	Yes´	Medium
Bolus	Yes	Yes	Easy	No	Easy	Yes	High
Imaging:							
Pictures	No	No	No	No	No	Yes	No
Iris	No	No	Medium	High	No	Yes	Medium
Retinal	No	No	Medium	High	No	Yes	High
Fingerprinting:							
Body marks	Yes	No	No	No	No	Yes	No
DNA	Yes	No	Difficult	High	No	No	High

reading and for automatic retrieving of transponders in the abattoir. The tagging devices and new developed equipment is being tested under specific laboratory protocols to warrant its utility under farm and abattoir conditions.

The second part of the project comprises of the study of methods for sampling and analysis of biological samples for DNA fingerprinting of cattle and pig. The DNA samples are used to audit the EID traceability under practical conditions. Data from EID and DNA profiling is processed, coded and stored in a newly developed data base provided with the necessary tools for data comparison and data retrieval.

The third part of the project is the implementation and validation of the whole traceability system (Figure 1) for beef and pork. Two production systems are considered for beef cattle (7,500 calves): 'red' (grazing steers) and 'pink' (baby-beef calves) beef; and for pigs (9,000 piglets): 'white' (crossbreeds in intensive) and 'black' (Iberian in extensive) pork. Additionally 2,000 lambs will also be traced**.**

Finally, the project includes an evaluation of the costs and a cost-benefit analysis of the traceability system in cattle, sheep and pigs under EU conditions. Estimated annual costs of using EID range between 4-10 • /animal with an extra cost of nearly 2 • when DNA sampling is included. DNA analysis cost varies between 5-15 • according to procedures, but less than 5% of samples need to be analyzed for auditing traceability. Mixed strategies are also interesting for animals slaughtered at young ages and they reduce costs. The cost-benefit analysis will determine the profitability of the EID+DNA system over an extended period of 10 years.

Animal data is collected electronically and is being automatically transferred first to a partner data base and then to a central data base for final checking and processing. Moreover, an important objective of the project is to achieve a widespread acceptance of the developed system from producers and consumers. Therefore, the methodology and results of the project will be disseminated to ensure that national authorities and international organizations are kept fully informed.

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French experience in animal identification and traceability

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Summary

As for the 15 states of the European Union, EU, an operational traceability has been existing in France for several years. An organisation for services to breeding, the OSB, owned by breeders under government's supervision operates traceability in addition to other services linked to animals such as performance and parentage recording, pedigree keeping, artificial insemination, genetic evaluations and sire selection and semen production. Since its establishment thirty years ago, the OSB had to cope with many changes. In 1970 less than 10% of animals were identified mainly for selection purpose while now the OSB operates traceability for 23 millions bovines and 250 000 breeders to meet food safety and beef market requirements. The OSB performs holding and animal numbering, data collection, checks and management, as well as their transmission to the Government's National Identification Data Base (NIDB) and assists breeders who pay 90 % of the costs. The NIDB is managed and paid by government who provides breeders with passports which are required when animals are moving from one holding to an other. To improve the system several projects have been launched, to use electronic identification, to increase electronic data transfer and to implement a quality management according the ISO standards.

Keywords: cattle sheep goat identification traceability.

Résumé

Comme pour les 15 pays membres de l'Union Européenne, UE, un système opérationnel de traçabilité existe en France depuis plusieurs années. Une organisation des services en élevage, OSE, gérés par les éleveurs et soumise au contrôle de l'Etat assure la traçabilité en plus d'autres services liés aux animaux comme le contrôle des performances, l'enregistrement des parentés, la tenue des livres généalogiques, l'insémination artificielle, l'évaluation génétique, la sélection des reproducteurs et la production de semence. Depuis sa création il y a trente ans, l'OSE a du faire face à de nombreux changements. En 1970

moins de 10 % des éleveurs et des animaux étaient identifiés principalement pour la sélection tandis qu'aujourd'hui cette organisation assure la traçabilité de 23 millions de bovins de 250 000 éleveurs pour satisfaire les exigences de sécurité alimentaire et du marché de la viande. L'OSE assure la numérotation des exploitations et des animaux, la collecte, la vérification et la gestion des données ainsi que leur envoi à la base de données nationale de l'identification, BDNI, de l'Etat et l'assistance aux éleveurs qui financent 90 % des coûts. La BDNI est gérée et financée par l'Etat qui fournit aux éleveurs les passeports des bovins qui sont exigés en cas de mouvements entre exploitations. Pour améliorer le système plusieurs projets ont été lancés pour utiliser l'identification électronique, accroître les échanges de données informatisés et pour mettre en place un management de la qualité conforme aux normes ISO. De plus, suite à une nouvelle réglementation européenne l'identification ovine et caprine sera rénovée en 2005.

Origin and evolution

Traceability is recent, but animal identification has been existing for a long time in France as in many other countries. Until the seventies, few animals were identified. Milk recording organisations, breed societies and animal health associations used different means of identification, such as tattoo or metallic ear tags, and different identification numbers. These systems were sound and met well the needs of each organisation but often the same animal could have several ear tags with different identification numbers and data exchange were difficult.

From 1970 to 1996

In 1970, mainly in order to increase the use of improved sires by artificial insemination, Government and farmer unions, established OSB for services to breeding. It had to provide cattle, sheep and goat breeders with parentage and performance recording, pedigree keeping, genetic evaluation and artificial insemination from improved sire.
A centralised animal electronic file of recorded animals was also created as well as data processing centres and a unit responsible for rules, standards and procedures for animal identification, parentage recording, performance recording and data management.
Though, many changes occurred, these basic principles remained unchanged until now.
From the seventies animal identification expanded. For cattle the main stages were, 1980, for the identification of all bovines of more than six months old for disease control and eradication and 1995, the identification of all the bovines at birth for premium check following the EU's decision to give animal subsidies.

The BSE crisis in 1996

In 1996, the Bovine Spongiform Encephalopathy, BSE, crisis occurred. It resulted in a dramatic decrease of beef consumption, about 25 % in France. At the end of 1997, in order to regain consumer confidence with full traceability, for food safety and to eradicate BSE, the EU decided to establish a compulsory labelling for beef based on cattle traceability from national data bases.
In 1998, the French government asked the OSB to operate cattle traceability because of its expertise in animal identification and animal data management. The implementation was rather fast. At the end of 1998 it was completed for breeders. In 2000, the National Identification Data Base, NIDB, designed with the assistance of the OSB, through Institut de l'Elevage, started from data already recorded by the OSB information system.

Legal frame work and organisation

The EU is responsible for the basic regulations to be implemented by the member states. Theses basics consist of holding definition, standards for farm and animal and identification, animal keeper's obligations, data to be recorded and sent to the Government.
The EU checks whether the member states comply with the European regulations.
Each government is responsible for the design and implementation of its own system, for complementary regulations, penalties for breaking the regulations and approvals of legal ear tags. In France a regulation defines the organisation of the OSB and the way to perform farm and animal identification, data checks and collection.
For identification and traceability, the OSB has 70 local operational units, called EDE, 10 data processing centres, called ARSOE and one unit to elaborate standards, rules and procedures implemented by EDE and ARSOE and to assist them, Institut de l'Elevage.
Government runs the NIDB which records data transmitted either by the OSB or directly by abattoirs.
Ear tags are approved by the government according tests designed and performed by the OSB through Institut de l'Elevage and EDE.

Implementation

The French organisation consists of three parts: farmidentification, animal identification and cattle traceability. Each one is relatively independent from although farm identification was required for animal identification and traceability. Their scope is also different according to the species: identification of all farmers with pigs, cattle, goats, poultry, and sheep; identification of all cattle, sheep and goats; traceability of all bovines and a part of sheep.

Farm identification: Objectives

The objective is to get a permanent unique identification number for holdings where cattle, sheep, goats and pigs are kept by farmers, traders, abattoirs and markets.

Implementation

Keeper of a holding has to ask the OSB through an EDE to give an identification number which is standardised and unique at the EU level. For France, the holding identification number consists of a two letter code for the country, 'FR' for France, and an eight digit code unique within France. Holding identification numbers, addresses, names and addresses of keepers are recorded by the OSB information system which delivers them to other OSB activities and sends them to the NIDB.

Scope

About 300 000 farms, 5 000 traders, 300 abattoirs and 100 markets are recorded.
Identification number, established thirty years ago, is now a widely used reference for many activities: cattle traceability, veterinary concerns, premium calculation, parentage keeping, performance recording, genetic evaluations, herd book keeping…

Animal identification: Objectives

The objective is to put a unique life time number on all cattle, sheep and goats. Keeper is responsible for animal identification. At the moment, plastic ear tags are the only legal means of identification.

Implementation

To get ear tags, breeders send an order to the OSB through an EDE. EDE checks whether ear tags can be delivered, decides what numbers will be printed on the ear tags, taking into account the already used identification numbers and passes on order by electronic data transfer to a manufacturer. The manufacturer sends the ear tags to the breeder. Orders as well as deliveries are recorded by EDE and passed on to the NIDB.
For cattle when an ear tag is missing a new one with the same identification number has to be put by the keeper.

Scope

In France 23 000000 bovines, 1 200000 goats and 9 000000 sheep are identified.

Cattle traceability: Objectives

This system deals only with cattle. The objective is to trace the holdings where a bovine, without delay, was reared from birth to slaughter in order to meet the needs for beef labelling, food safety, food quality, veterinary concerns as well as premium checks. This system is operational for all the EU.

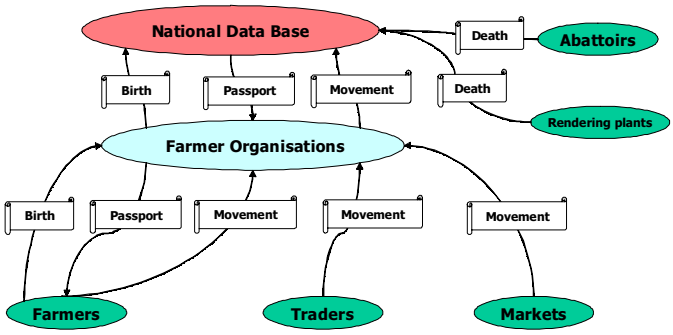

Figure 1 - Organisation and data flow for cattle traceability.

Implementation at birth

Within seven days from the birth, the keeper puts two ear tags on a calf and sends information to OSB, through an EDE, either by internet or by mail. The information consists of an animal identification number, the holding identification number, a sex code, a breed code and the birth date.
EDE checks the data, passes them to the NIDB by electronic data transfer and stores the data in the OSB information system available to the other OSB activities.
If a breeder has decided to do parentage recording, complementary checks are performed in relation with dates of artificial insemination or natural services.
About 8 000000 births were recorded in France in 2003 as well as 3 000 000 parentages.
Within a few days, the NIDB elaborates the passport of the animal which is transmitted to the breeder through an EDE. It is illegal to move or to slaughter an animal which has not at least two ear tags and one passport. Breaking the rules, keepers may incur important penalties.

Implementation for animal movements

When an animal enters or leaves a holding, any keeper has to fill in the passport and to send information to the OSB through an EDE. Information consists of animal identification, holding identification, the date of arrival or departure. The data are recorded by the OSB information system. In 2003 about 40 000 000 movements were recorded.

Implementation at slaughter

Abattoirs as well as rendering plans must send animal identification numbers and dates of slaughter directly to the NIDB. In 2003, 6 000 000 slaughters were recorded.

Economic aspects: Cattle identification and traceability

Ninety-five percent of the OSB costs are paid by the industry of which 90% are breeders. The cost is about 7 Euros per year/calf consisting of 25% for ear tag manufacturing, delivery and replacement, 25% for the information system, 25% for the passport and 25% for the assistance and management. One hundred percent of the costs of NDIB are covered by the government.

Sheep and goat identification

Ninety-five percent of OSB costs are paid by the industry of which 90% are breeders. The cost is about 0.3 Euros per year and per ewe or per goat consisting in ¾ for ear tags and ¼ for assistance and management.

Future developments

Traceability cost is rather high and it requires much administrative work. Several projects have been launched in order either to reduce the costs or to increase the value of the services. They deal with the use of electronic identification, the increase of electronic data transfer, and quality management according to the ISO standards. The sheep and goat identification will be renewed in 2005 following recent changes in the EU regulations.

Main conclusions: Identification

Following the BSE crisis, now fifteen national organisations are operating full cattle traceability in the EU. Several important issues can be drawn from the French experience as well as from the other European systems. Efficient animal identification can be performed by partners, such as farms, commercial companies or a public administrations, for their particular needs. Manufacturers could provide reliable ear tags and software without any government implication. If more private or public activities need animal identification, and if data needs for exchange increase, an appropriate solution consists of a shared identification system meeting the different needs. This solution is rather low cost and can be appropriate even if a low percentage of animal and few organisations are involved.

Traceability

Identification and traceability are two different things. Animal traceability requires a reliable shared identification system for all the animals. Births, movements from one holding to an other and slaughters should be recorded without delay by an information system able to deliver them tothe industry and to the government. The result in traceability cost is almost twice the identification cost. Furthermore the cost is independent from the individual animal value: costs per animal are almost the same

for cattle and sheep. Consequently traceability is relevant only if animal value allows it and if market conditions require it. In the EU, following the BSE crisis, the cost of traceability was the price to keep a significant beef market.

Organisation requirements and critical issues

A shared animal identification and/or traceability requires government and industry involvment. The government in cooperation with the industry should at least define the common standards for animal and holding identification as well as establish a specialised organisation to operate the system and to finance it at starting. Such organisation should be managed and financed by the industry under government supervision to trust the system and the services mets the public needs at a reasonable cost. This organisation should have expertise in animal identification and/or traceability, in information system engineering as well as in project management to be able to address the critical issues which are the organisation of holding and animal numbering, ear tag delivery and information system implementation.

Delay and cost

Implemention of shared identification and/or traceability requires much money and time. Two or three years are required to set up an operational service. This time is necessary for the organisation, design, and implementation, to gain the user's trust and to involve them by communication and education.

New identification system of national livestock in Tunisia

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Summary

In Tunisia a new numeric identification system using plastic ear tags unviolable and laser engraved has been introduced since 2002 to progressively replace the old method using tattooing alpha numeric practices used since the sixties.
This was done to assure a bigger cover of national livestock through identification and to improve quality of recording of zootechnical and health aspects, to get a data base that allows having traceability under its wide aspects: zootechnical, genetical, health, administrative and economical with regard to new positioning and integration of the national economy within the globalization context.
The new identification program relies on the following 4 main issues: Structural organisation; information collection system, management of national data bank, follow up of regulated diseases and rules and procedures of implementation by different operators in the sector. Cattle identified and recorded are rewarded «an official certificate of identification» joining the animal during all its life, travel and transportation and serves to follow up zootechnical, health and traceability features.

Key words: identification, cattle, passport, traceability.

Introduction

With 450310 female units of cattle in 2003, cattle represent an important source of proteins within Tunisian food diet. Tunisia has now a self sufficiency status for red meat. National production in 2003 is around 11 0700 metric tons with an average annual consumption of 11.4 kg / person.
Consumers attitude toward their diet evolved during these last years. Price and lack of risk (safety) became major factors of their choices.

Consumers expressed clearly their requirement of safety during various food crises. Recent episode of BSE or commonly called disease of crazy cows and the need to re-establish consumer confidence have incited Tunisian public power to start defining «national strategy of livestock identification, labeling, and traceability of red meat».

Objectives of the new identification system

It is useful to remind that official animal identification was introduced in Tunisia since the sixties for performances' follow up of the first 250 dairy cows imported then Marking of animals was made by tattooing of alpha numeric number on animal ear. But given its limits and health danger, this technic was dropped out since 2002 and a new numeric identification system was introduced using plastic ear tags, inviolable and laser graved. This method will enable extending this technic to cover all cattle livestock (2 million heads) by 2010, to assure recording of identification data, health and moving follow up through passport establishment for cattle. In fact, this will assure follow up and traceability from birth to slaughter of registered animals (Figure 1).

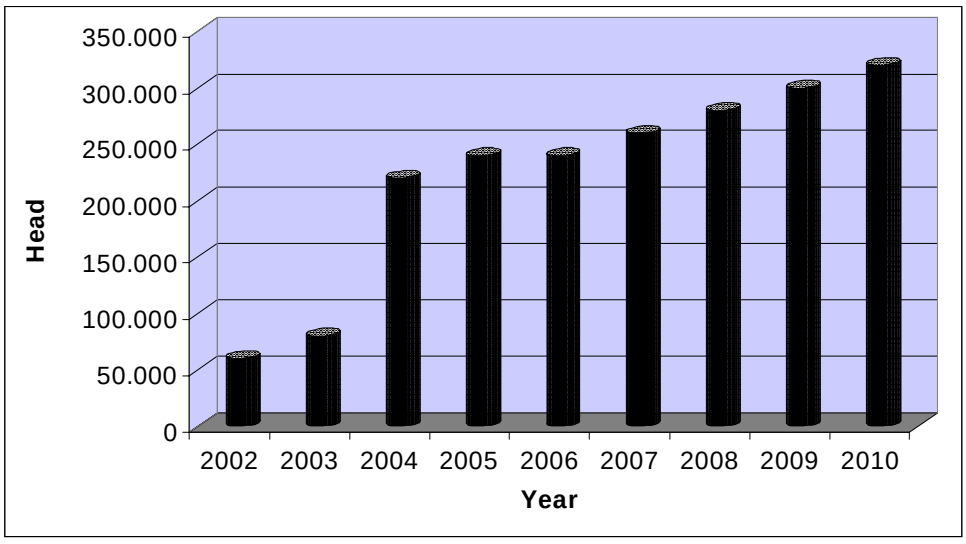

Figure 1. Evolution of cattle identification.

In addition to its positive impact on zootechnic and genetic improvement programs' management, this new identification system represents a must and an essential instrument in order to set up a traceability global system at the level of food chains for red meat and to strengthen Tunisian consumer confidence in national production and to guarantee, in the frame of globalization, positioning and better integration of national economy.

Components of the new identification system

The elaboration of the guideline of rules and procedures, the full implementation of the new identification system requires several accompanying measures which will enable to achieve programs in time and in the best way with regard to projections and to expectations considering livestock specificities in Tunisia.

Sevently percent of cattle are held by small and medium size farmers owning less than 10 cows and 10 hectares of land each. Accordingly, a certain number of measures and elements were taken into consideration to assure livestock holders' adhesion and to enhance success of program implementation, such us:

- Set up of a unique official numeric identification system for all livestock. This system is made up of 12 characters, including the ISO code of Tunisia "TN" followed by a series of 10 numbers of which the first two refer to the area (gouvernorate) code of the farmer and the 8 remaining numbers refer to the individual animal .
- Using laser engraved, inviolable plastic ear tags printed by an OEP managed unit.
- Introduction of farmer kept records of all animal entries and exits on the farm and their information to the animal recording organisation.
- Ear tags and their put up are free of charges to small and medium farmers with support of public funds.
- Set up of national data base on animal identification, production and health follow for a better use of results by different stakeholders at national and regional levels. The national identification data base (BNDI) managed by OEP will be linked through a server and optical fiber to the animal health data base kept by the Directorate General of Veterinary Services (DGSV). Through this connection the BNDI animal passports/certificates for animal movements (trade or slaughter) will be updated with information about contagious diseases.
- Involve progressively private and professional operators in the implementation of the new identification program.
- Livestock legislation in preparation will constitute a new framework for all zootechnical, genetic and health programs and activities by the public and private sector.
- In the initial phase OEP will continue to carry out the implementation of the identification program. In a second phase identification and recording tasks will be progressively carried out by the organized farm sector, including OTD, UCP, SMVDA and the big size farmers. In a third phase, the agricultural and professional organizations and private operators will be able to carry out these duties with the small and medium size farmers after the specific guidelines have been prepared for this activity (Figure 2).

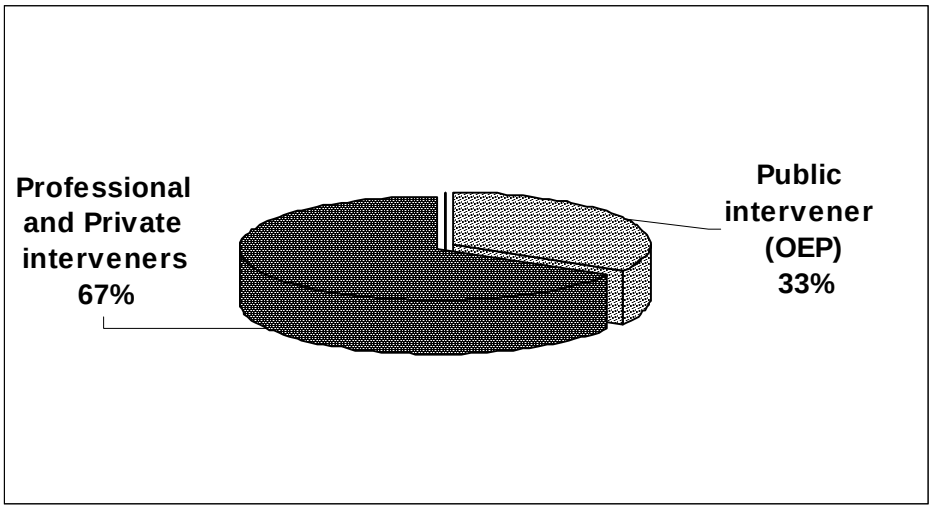

Figure 2. Contribution of public, professional and private interveners in cattle identification programmme.

Financial sources of new identification program

It is estimated that the total investment to implement this identification program will be 4 million dinars. Of this sum the World Bank project "Support to Agriculture Services" is expected to provide about 2.3 million dinars, the State budget for 1.0 million dinars and the contribution of the big farmers is estimated at 0.720 million dinars, the latter starting from the 4th year of the program (Figure 3).

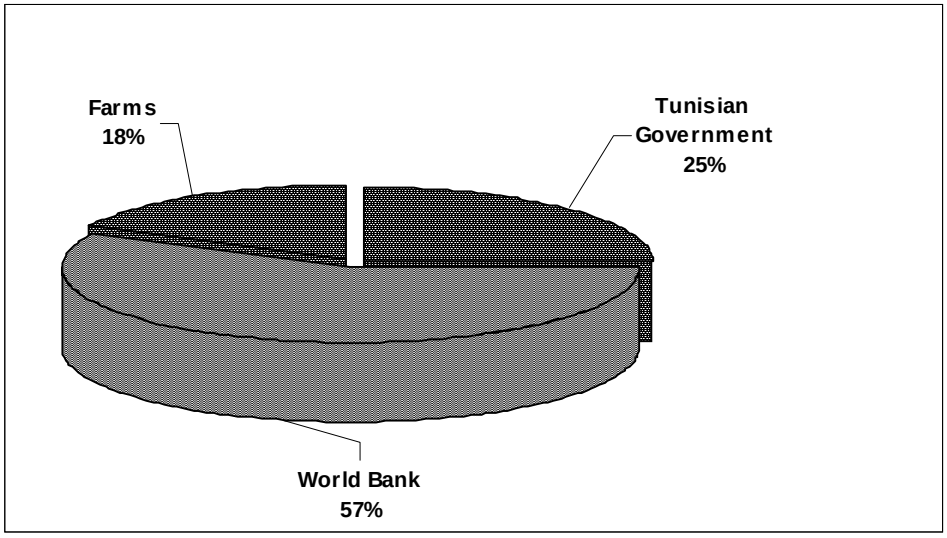

Figure 3. Financial sources for cattle identification program (million DT).

Conclusion

Since January 2002, calves, cows and bulls are identified with plastic yellow, laser engraved ear tags to assure labeling and traceability of red meat in the consumer market. When this first link of traceability is mastered successfully, the other links can be achieved with continuous control of traceability of the animal an its products from birth to slaughtering.

In addition, with the promulgation of livestock law and by setting up standardized programs of animal marketing and slaughters, improvements of product quality and competitiveness will be realized. This will eventually give the red meat sector an opportunity of reaching also foreign markets with certified products.

Consultant's view on successful planning of I&R

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Summary

Following the establishment of Animal I&R systems throughout all EU member states, further countries are currently planning and implementing national Animal I&R systems in order to ensure international market access. Successful implementation of I&R is usually undertaken with the technical assistance of international consultants. The efforts involved in implementing a successful I&R system are often underestimated either by the beneficiaries and stakeholders and also by the donors. It is thus one of the major tasks of the consultants to assist the project partners in the planning of a sound approach for the Animal I&R which is technically, organisationally and economically feasible and is based on a careful and sound evaluation of country specific condition applying for all aspects of I&R.

Key words: traceability, animal identification, animal registration, eartags, cattle database, animal movements, agricultural consulting, I&R.

Introduction

Effective traceability systems, both for live animals and animal products, underpin the ability of national authorities to rapidly respond to disease outbreaks and food safety incidents. They allow the source of problems to be identified, their full implications to be understood and the necessary control actions to be taken. As such, they have an essential role in ensuring consumer confidence in the safety and integrity of the food chain. In particular, the European Union has formulated a new food safety policy with an integrated approach for the safety of products of animal origin, the so called "from farm to fork" or "from stable to table" concept. This policy is aiming to maintain consumer confidence and to ensure an effective functioning of the internal market of the EU.

The registration of holdings, animals and animal movements forms a fundamental part of any traceability system. Almost all member states of the European Union have successfully implemented an Animal I&R system for cattle, using a national database, as required by the respective EU legislation. Animal I&R systems for pigs, sheep and goats are in the process of implementation or the launching of those systems is planned for, in the near future. In almost all of the EU member states it was necessary to develop totally new systems. These new systems in many cases could only use limited parts of the existing Animal identification and registration systems that were set up in the past for breeding, recording, herd management and local health control purposes and often covered only a certain part of the total animal population. As a consequence, huge investments in hard- and software as well as in adequate staff and technical resources were necessary to develop and implement a successful system.

However, while applying these systems throughout the EU it became obvious that those requirements would also be imposed on third countries exporting live animals or animal products to the EU. Based on these trends it can be expected that world trade requirements will demand a functioning Animal I&R system for any exporting country of livestock and animal products.

In recent years national and international donors of Technical Assistance programmes have emphasized the importance of the implementation of reliable Animal I&R systems as a core requirement to assure future international market access for livestock and products of animal origin. International funded projects on Animal I&R outside the EU member states are currently planned or on-going in Albania, Bosnia & Herzegovina, Botswana, Bulgaria, Chile, Jamaica, Kosovo, Lithuania, Macedonia, Romania, Serbia, Turkey, Ukraine and other countries.

However, establishing an Animal I&R system is a major project, typically demanding many man-years of work to complete. The implementation of such systems requires a sound legal, organisational and operational basis with adequate human and financial resources, as well as adequate IT-systems for data entry, validation and correction, data storage and for the distribution of information to farmers and veterinarians.

The efforts needed in order to achieve a successful implementation of the systems are often underestimated by the beneficiaries and stakeholders as well as by the donors. The following paper describes the role of the Consultant within the process of system planning and system implementation. Based on experiences gained from already completed and on-going projects the authors have opted for a more systematic approach for project planning and implementation and present their consideration on key issues for system implementation.

Consultants role in Animal I&R projects

Consultants are frequently contracted by donors to assist in the planning and implementation of an Animal I&R system for a specific beneficiary country and its relevant institutions involved in Animal I&R. In this

context it is the responsibility of the Consultant to combine the technical, project budgetary and timing expectations of the donor with the specific situation in the beneficiary country in respect of the availability of technical, financial and human resources before arriving at the solution.

Expectation of the donor

The expectations of the donor mostly result from internationally agreed public and animal health policies. However, those expectations are modified to the specific interest of a donor in his specific sphere of influence. In this respect, the European Union is imposing the same standards for Animal I&R on third countries as for its EU member states if those countries are interested in exporting livestock or livestock products to the EU.

Donors providing technical assistance projects on Animal I&R very often expect a turnkey solution allowing for only little variation from the desired standards. However, straightforward extension of existing I&R systems may fail, due to different socio-economic conditions applying in most of the beneficiary countries. Other complications may arise from different farm structures, different organisation of livestock and veterinary services, different professional skills of the keepers, other communication facilities or limited financial means etc. In addition ethnic frictions might complicate the situation. In total, all those restrictions complicate the simple copying of already existing systems and prevent the quick implementation normally expected by the donor.

The donor mostly administers public funds. Therefore, from the donor's standpoint the consultant is expected to cope with a very formal administrative procurement approach. Accordingly, there is a big additional risk of excessive bureaucracy and administrative burden resulting in considerable interference with the development of the project.

Expectation of the beneficiary

In the first instance, the desire of the beneficiary to implement an Animal I&R, is politically driven in order to maintain market access for their livestock products. However, as most of the beneficiary institutions have only limited experience of the practical operation of an Animal I&R, they underestimate the efforts needed to establish and operate a comprehensive Animal I&R system. Accordingly there is the tendency to delegate important decisions to the consultants and to expect a turnkey solution especially in the beginning of the system planning phase.

Ownership and responsibility of the Animal I&R system are only gradually taken over as the project progresses. This, however, involves a certain risk, in that the beneficiary – in view of his responsibility – may wish to modify the basic approach, as initially designed at the inception phase, at an advanced stage of the project where redesigning would impede the project's progress.

Role of the Consultant in Animal I&R projects

Although facing the expectations to deliver a turnkey solution the only way for the Consultant to act is as an advisor and mediator between the deviating expectations of the donor and of the beneficiary on the one hand and the requirements of a functional and sustainable I&R system in the background of country-specific conditions, on the other hand. In particular in the planning phase of the Animal I&R project it is thus the major task of the Consultant to provide a comprehensive system description and to assist in the analysis of all relevant aspects for the operation of an Animal I&R system and to help donors and beneficiaries to agree on a feasible approach that fits to the specific countries condition. It is necessary that ownership and responsibility for the system should be taken over by the competent organisation within the beneficiary country in the early phase of the project. For this purpose study tours and training activities, are another priority task to be undertaken in the initial phase in order to create the necessary expertise within the competent authority. It is a recommendation to assign a sufficient time period for the planning phase of the Animal I&R system with a minimum of 6 to 9 month before starting with system implementation.

Recommendations for the successful planning of an Animal I&R system

Successful planning of an I&R system can be seen as systematic approach where complex interacting and independent I&R components are assembled, customized according to the national profile, and finally formed into an efficient, coherent, and stable I&R system. The following chapter is divided into two parts. The first part presents the main conditions and factors to be considered when starting with the design of the general framework of the Animal I&R system. The second part outlines technical key issues to be considered when planning the detailed operation of the Animal I&R system.

Analysis of framework and system planning.

Description of the animal production system within the country

The description shall ensure a thorough understanding of the animal production sector and should include aspects such as livestock farm structure, regional distribution and density of livestock species, productivity of the animals, seasonal distribution of calving, animal movements by owners / traders, use of village and / or mountain pastures, structure of livestock markets and abattoirs, organisation of public veterinary services, availability of private veterinarians, availability and organisation of livestock services (recording / AI) and others.

Analysis of expectation of consumers within in the country

After the BSE outbreak, most consumers have become more aware of health issues in view ofthe possible implications for human health of food of animal origin and of beef in particular. It should be established to what extent a high level of veterinary public health and the need for the traceability of food of animal origin is a priority for consumers and in addition what is already laid down as a political objective in the country's food safety policy.

Analysis of relevant markets for animals and animal products including export and import

In a careful market analysis on animals and animal products it should be determined what are the main trends in the country's animal production figures and its foreign trade (import/export) of animals or animal products. As an important goal, the economical relevance of international market access has to be evaluated as a major benefit of the introduction of an Animal I&R system.

Analysis of legal framework and description of the situation of animal health and veterinary public health

The Country's veterinary legislation for animal health and veterinary public health has to be reviewed in order to identify relevant aspects and requirements for the introduction of the Animal I&R system. If it is of importance for the countries trade relations, then the relevant international standards, such as from OIE, or from important trade partners (such as EU) must be included in order to obtain a complete picture of the relevant legal requirements in order to be able to draft an appropriate legal base for the I&R system.
Beside the veterinary legislation other legal conditions within the country have to be reviewed such as premiums for animal husbandry, livestock breeding, data management and statistics if they have any impact on requirements for the introduction of the Animal I&R system.
It is further necessary to make available an up-to-date report on the country's situation and status on animal health and veterinary public health in order to analyse if there are specific aspects to be considered for the Animal I&R system implementation.

Clarification on the willingness of the stakeholders to participate in any proposed I&R system

In the context of a lacking of awareness about Animal I&R, it might happen that commitments are entered into by the beneficiary country without full consideration of the implications resulting from introduction of I&R. Therefore it is essential to clarify the willingness of the stakeholders to participate in the project. This can be done by questionnaires and appropriate workshops as well as by the formation of working groups of all the involved stakeholders.
Livestock farmers represent the most important stakeholders of I&R. In this respect it should be noted that farmers from EU countries mainly comply with I&R requirements because of high subsidies which are paid on the basis of (error-free) animals stored in the central database. When no subsidies are applied, considerably less compliance can be expected. Therefore, detailing the private benefits and strict compliance requirements are the only means for ensuring satisfactory participation in I&R. This applies particularly in situations where farmers will ultimately have to fund the system costs.
Transparency in a functional I&R system usually causes difficulties with cattle traders who may wish to hide the origin of animals as a trade secret or sometimes illegally import animals without the necessary health

certificates from abroad. Therefore animal traders often strenuously oppose the introduction of I&R and can severely interfere with its implementation.
If such obstacles are identified the only way to overcome these is a countrywide promotion campaign, where the reasons, objectives and benefits are explained to the farmers and other stakeholders. In this respect, the associated private benefits should be highlighted such as the health protection to one's own animals, the proof of ownership, the prestige of participation in a modern I&R system and the prevention of difficulties with state authorities.

Definition of relevant objectives?

As already indicated an Animal I&R system has to serve several purposes beside the primary veterinary purpose, namely to provide a tool for animal and holdings identification and animal tracing in case of disease outbreaks. It is important to identify those purposes as they might help to justify the introduction of the system and to ensure proper financing. Other objectives may be the execution of preventive measures, allocation of subsidies, animal recording, animal breeding, provision of national statistics, private veterinary purposes, animal insurance, prevention of fraud and others.

Calculation of costs

The calculation of the costs of an Animal I&R system is an important activity which has to be considered side by side with the detailed planning of an Animal I&R system. In principle costs have to be calculated for relevant investments and initial activities as well as for the maintenance and the on-going operation of the system.
Investment and initial costs may arise from the following components:

- Costs for establishing the central I&R infrastructure such as for office premises and equipment, hardware and others;
- Costs for central data base software including its customization and additional programming;
- Costs for establishing the holding register in case of a census including relevant services and the data entry;
- Costs for execution of the first tagging campaign such as ear tags and pliers, cattle passports and communication costs.

The calculation of costs for the on-going operation has to consider components such as for:

- Central Animal I&R unit staff;
- Ear tags for animal identification and replacements;
- Animal I&R forms and / or passports;
- I&R service fees (including travel);
- Depreciation;
- Inspection;
- Communication and mail charges.

Definition of financing concept for the investments and the operation of the system

While there is a good opportunity to cover the investment and initial costs to a certain extent by TA and procurement projects of international donors, the costs for the maintenance and operation of the Animal I&R system have to be financed from sources within the beneficiary country. It is recommend that in the initial phase, a major part should be covered from the national Governmental budget, but it is reasonable to gradually increase the proportion funded by farmers and other stakeholders.

Cost-Benefit analysis

One purpose of the cost calculation is to prepare a precise budgetary plan for the implementation of the I&R system. The other purpose is to evaluate the costs compared to the benefits expected (such as a public good for consumers or international market access) in order to justify whether the proposed system is of benefit to the country and if it is economically feasible.

Technical key issues

Organisation of data capture

Complete, timely and correct data capture is a sensitive issue with regard to I&R system integrity and system robustness. In this respect, data capture by handwritten forms is more risky as an average error rate of about 3 % per character applies in practice. On the other hand, automated scanning of the holding or animal's information from appropriate barcodes allows for almost error free data capture. At present, there are many Pocket PCs featuring integrated scanners on the market and their use allows for immediate and accurate recording on the spot.

Software development or software procurement

Development of software for registering the animals in a central database and including all movements up to the animal's death sounds very easy in principle. Therefore, beneficiary countries often opt for own software development in the first instance. However, when the software functionality is analysed in detail, it becomes apparent that the software needs to be highly sophisticated and requires many man years of work for its successful completion. Therefore national attempts to develop own software are often delayed or have been found to fail.
Because of the often tightly set time schedule for I&R project, there is almost no alternative but to procure the appropriate software packages from the market. In this respect it should be noted that no commercial I&R software has been approved by the EU up to now.

Numbering system: for holdings, for herds or for each individual animal

Unique numbers for holdings and animals form the basis of the I&R system. In order to avoid communication errors, the animal or holding ID should be as small as possible with the constraint that a minimum turn-over period of 100 years should be provided. Due to lack of experience, the beneficiary often tries to put additional information into the number, such as birth region, breed, municipality code etc. The consultant should strictly oppose such proposals, as this additional

information usually looses it's value but significantly inflates the number of digits and therefore leads to additional communication errors as well as to higher costs for ear tag handling and distribution.
The internal animal ID used within the database or on barcodes should be represented by an appropriate 15-digits ISO code (3-digit country code, followed by '00' and the 10 digit animal ID, where leading '0' fill up to 10 digits) in order to provide world wide uniqueness and to match with numbering system applied in many other countries.

Identification/ear tagging: by farmers, by veterinarians or personnel of other support services

In principle it should be clear that the keeper always takes responsibility for the correct application of I&R issues within his herd. However, there might be situations where due small farm structure or poor keeper skills etc. the I&R services may need to be assigned to 3rd parties.
I&R service providers may comprise of veterinaries, AI staff or trained staff responsible for certain defined holdings or regions. In principle there is no preference of any of those subgroups so long as easy and continuous access to the keepers is ensured. However, where the service providers are equipped with expensive devices such as Pocket PCs, scanners and communication lines to the central data base, the number of service providers must be limited to such numbers as can be funded from the available budget. In any case the design should avoid to create a job machine for specific occupational groups as the utilisation of service providers for Animal I&R may increase system operation costs by more than 20 %.

Work flow, data flow

The I&R system covers a wide range of activities applied in different places and application areas. It is strongly recommended to address the entirety of a activities by a written I&R workflow document which additionally specifies each of the planned working steps and the order of execution. Additionally, the triggered data flow should be described. Typically, the workflow document includes the following issues:

- Farm Census for establishment of holding register (in case there is one);
- Maintenance of keeper/holding addresses – new/change of information;
- Ordering and allocation of new and replacement ear tags;
- Withdrawal of the ear tags;
- First tagging campaign;
- Notification of births;
- Routine registration and tagging;
- Issuing of Cattle Passports;
- Communication of movements (leaving, entering, death), (farm; abattoir; livestock markets; fairs; alpine grazing areas; village pastures);
- Re-prints of forms;
- Importation of animals (from countries following EU rules; from third countries);

- Exportation of animals;
- Error correction procedure (in the field; centrally), (a priory; a posteriory);
- On spot inspections.

By this means, the entirety of system elements becomes visible and weaknesses in respect of crude system planning become evident. The workflow document forms the final base for further planning of systems details. In order to avoid severe revision of the implementation process, the basic workflow should be seen as a binding document, which should be agreed on by the beneficiary.

Control of I&R

From the background of a strong data connectedness, maintenance of the I&R requires strict compliance of all participants as failures, e.g. missing participation, missing or delayed registration, missing or delayed communication of movements etc., result in corrupted data that quickly may lead to propagated errors of the central database and loss of data integrity. Therefore, participance and full compliance with the I&R system needs to be ensured by appropriate means.

In this respect, minimum control by inspections as e.g. formulated by EU Commission Regulation (EC) No 2630/97 are only slightly capable of improving the farmers' compliance, as control density still remains at a low level. In cases where private benefits such as granting subsidies based on correct data entries are not existing, the 10 % minimum level of controls might not be enough to create I&R awareness and to ensure collaboration of the farmers. Therefore it is strongly recommended to implement additional advice and support for the farmers rather than imposing fines to them in case of irregularities. This applies in particular for the initial phase after implementation when farmers still need to become familiar with the system. Other than official inspections, this task can be overtaken by service units commissioned with the execution if I&R services. If the number of communications falls below 1 event per cow and year this should be seen as indicator for visiting and advising the farm how to perform correctly.

Animal identification and recording systems in the Southern African Development Community (SADC): 1. Overview of the current situation

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Summary

There are different animal identification systems in operation in most of the SADC countries, whilst some have not implemented any form of a legal and uniform system on a national scale at all. During August 1999, the SADC Council of Ministers had agreed that all member states should embark on a sound livestock identification, trace back, and information system. Countries not participating in such an arrangement would risk exclusion from future trade within the region and will not be part of negotiations, as a unified regional economic block, with other markets in Africa and abroad. This situation would penalise the smaller and often impoverished farmers who rely heavily on livestock for their subsistence and indeed, survival. In this paper an overview of the current situation in the SADC region is given.

Key words: animal, branding, identification, microchip, recording, SADC member countries, tattooing.

Introduction

There are two different approaches to the identification of animals. In the first instance, one may have a system whereby all the animals belonging to a particular owner are identified with the same identification mark. The aim of such a system is to prove, beyond any reasonable doubt, the ownership of any animal in the herd or flock. The second approach to the identification of animals is to identify each animal within the herd or flock individually with a unique numbering system. The aim of such an approach is not to prove ownership, but to be a management tool in animal husbandry. Without identification of each animal individually the livestock owner cannot do performance evaluation, genetic selection, keep proper health records, accurately measure production, or perform many of the other important management functions required to run an effective and productive herd or flock.

Issues of responsibility

The important issue, however, is whose responsibility it is to curb stock theft, and whose responsibility it is to ensure proper animal husbandry practices. Since theft, whether it be cars, livestock, property, or whatever, is a national issue affecting the well being of the entire nation, it shall always remain the responsibility of the State to implement measures and legislation to address theft and prosecuting criminals. There is little doubt that a formal, legalised, national system of identification is the only solution to the problem of positively identifying animals belonging to a particular owner to stamp out stock theft as far as possible. As was argued earlier, it is the sole responsibility of the government to implement and maintain such a system. This national and therefore compulsory system has to be supported by a sound legal infrastructure, i.e. a political will, laws, regulations, policing, independent courts and proper punishment. However, the livestock owner also has a responsibility in this regard as it remains one's duty to protect one's own property.

On the other hand, the higher productivity and well being of the herd or flock of the livestock owner is in his/her own financial interest. Hence, the responsibility to individually identify animals within a flock or herd for purposes other than to curb theft firmly lies with the individual livestock owner. The important aspect to remember is that the identification of the individual animal within the herd, need not either be expensive, nor necessarily permanent. Plastic ear tags, rubber leg bands, ear notching, and such other inexpensive identification methods are widely used all over the world for performance record, production and veterinary treatment purposes.

Reasons for identification

As a result of globalisation and the growth in the world population, in recent years other important reasons for the identification of animals, whether it be by a mark to identify the owner, or an individual mark to identify each animal uniquely, became a necessity.

Firstly there are zoo-sanitary needs such as movement control, trace-back to origin, international trade requirements and the prevention of the spreading of diseases. Whether each animal must be individually identified, or whether the identification must be on a flock, owner, area, village, district or national basis, remains open to debate. There is no question that such a system should also be the responsibility of the State. It stands to reason that the best solution would be if the identification system to prevent stock theft could at the same time be used for zoo-sanitary purposes. It makes little sense to have different identification systems, both managed by the government, but for different purposes. In the case of the developing world, it is also very important to consider cost and sustainability when designing such a system.

Secondly there is the question of food security. It is a well-known fact that the Southern Oscillation (also known as the *El Niño* phenomenon) has a detrimental effect on food production in the southern parts of Africa with some areas indeed more prone to devastating droughts. If there is to be any form of basic planning to be done on the potential for food

production it is imperative that the current status of food production be known in much greater detail. Across the SADC region statistical information and proper data are often sadly lacking. One of the reasons being that it is mostly impossible to get accurate figures on livestock numbers and marketing data, simply because farmers either don't keep accurate numbers, or refuse to give accurate numbers, or the infrastructure to collect and analyse the data is not available. Should a proper livestock identification, marking, registration, trace back and marketing system be in place, much needed data can be generated on issues such as current and potential production, reproduction and fertility, mortality rate, movement, production cycles, off-take and marketing. The basis of this is proper animal identification per region, district and area. Movement of animals and animal products in times of a crisis from "production excess" areas to "production deficit" areas within the SADC region potentially holds many food security benefits for smaller farmers, and naturally, all the people in the sub-region.
The purpose of this paper is to give an overview of the current status of animal identification systems in the SADC member countries and also to describe possible problems and flaws to assist other countries to develop systems not having these pitfalls that may seriously affect the success of implementing a new system.

South Africa

The South African branding and tattooing system to identify animals belonging to a particular owner is in operation since the late 1800's. Before unification each of the two British colonies, i.e. the Cape of Good Hope and Natal, as well as the two independent (at the time) Republics of the Orange Free State and the Transvaal had their own pieces of legislation regarding animal identification and stock theft. These separate pieces of legislation were in place until 1962 when they were combined into a single Livestock Brands Act. Although attempts were made during the past decade to streamline and modernise the 1962 legislation, pressure from various interest groups to retain outdated ideas and systems, resulted in the new legislation and administration still having serious flaws.
Probably the biggest problem is that the South African system has been in operation for such a long time. Since it wasn't compulsory to brand or tattoo animals for almost a century, farmers were allowed to do as they pleased and it is difficult to convince them to strictly adhere to the law.
A second important problem is that back in the early 1960's, the South African government centralised the entire animal identification system. In the days before centralisation the magisterial districts each kept an own register and also had its own unique identification mark for the owners in that district. In this system it was also possible to ask for one's initials to be incorporated in the brand/tattoo. The district brands and the personalised brands/tattoo disappeared as a result of the 1962 centralisation process. The old provincial systems (1890 to 1962) were suddenly replaced with a system whereby all brands were issued in a strictly alphabetical order. Since branding and tattooing were not

compulsory, and there were also no inspectors enforcing the law, livestock owners did not use these unwanted newly issued brand and tattoo marks. They simply kept on using their old outdated identification marks obtained before the 1962 legislation.

A third problem is that South Africa does not yet have a specific mark identifying animals of South African origin. This is in spite of the country's commitment in the Draft Memorandum of Agreement, drawn up in 1999, to do so. Animals found in cross-border operations by the South African Police Services and the Police Services of neighbouring countries cannot be identified by country of origin. With the serious threat of diseases like Foot and Mouth Disease, Johne's disease, Scrapie, Lung Sickness, BSE and others ever prevalent in the SADC region, it makes a lot of sense to clearly identify each animal originating from a particular country.

Fourthly, as a result of the centralisation in 1962, the entire system is managed by only a handful of staff in a central office in Pretoria. With a livestock population of approximately 13 million cattle, 25 million sheep, one million goats and thousands animals of other species to be identified, it is simply impossible for a single inspector to do the necessary inspections. Because of this lack of a proper inspection service for more than 100 years (1890 to 1990), the farmers basically did as they pleased. Many farmers simply ignored the branding laws.

Fifthly, the administrative processes and the documentation in the central office in Pretoria are not up to acceptable standards. The security is poor and documentation / certificates have absolutely no security features. A stock thief may therefore steal unmarked animals, brand them with a fictitious mark, manufacture a "legal" looking registration certificate, and keep or sell these animals without anyone ever noticing. Likewise, if the animals are already branded, the stock thief can simply forge an official looking registration certificate to show his / her name, and sell the animals. Since the South African system is centralised and hundreds of kilometres (up to 1,600 kilometres in some instances) away from the actual applicants, only a very small percentage of applicants personally visit the offices. It is therefore quite possible for any person to walk in with a stack of application forms made out in the names of every thief involved in a syndicate. The Registrar's office will issue registration certificates to these people without any form of positive identification.

A sixth complicating factor is that stud breeders are exempted from the provisions of the South African legislation. All stud breeders identify their animals according to the rules of the more than 60 individual livestock breeders' societies incorporated with the South African Stud Book and Livestock Improvement Association, and not according to the prescribed legislation. Furthermore, breeders' societies are, by law, allowed to issue numbers and letters to their members without any prior consultation with either the Registrar of Brands or with any of the other breeders' societies. The result of this confusion is that there are thousands of animals in South Africa, belonging to different stud breeders and even other commercial farmers / livestock owners bearing exactly the same identification marks. Not even the legal marks issued by the Registrar

are unique. To add to this, there are even breeders' societies that are completely exempted from placing any mark on stud animals at all. They are allowed to use photographs and drawings to identify the animals. This leads to a situation where members of the South African Police Services have no form of easily available identification to find the real owner of stolen livestock.

The seventh problem is that the South African legislation does not provide for a renewal of the identification mark on a fixed term basis. When the current registration data was computerised in the early 1990's, it was found that there were literally tens of thousands of people with postal addresses that were invalid. There was therefore no way to find out if a livestock owner was still farming and if the postal address was still correct. Although the legislation provides for a process by which deceased owners' registrations shall either be cancelled or transferred, or that the Registrar shall be notified of address changes, nobody ever bothered to do this. It is also a well-known fact that data capturing typists make a lot of mistakes, generally known as "finger trouble". Many computer systems therefore provides for double capturing of data so that the computer will automatically check for mistakes made by either one of the two data typists. This is not the situation in the office of the South African Registrar. There is little doubt that a large percentage of the data on the South African database are worthless.

The eighth problem came about when the system was re-designed in 1962. It was decided at the time that the identification marks should be allocated alphabetically and that all identification marks would consist of three alphabetical letters only. Unfortunately such a system using three upright characters in all its various combinations only allows for 17 576 different combinations. Since there are many more livestock owners than this, it was then decided to rotate the letters through 90°, 180°, or 270° in order to vastly increase the number of computations. Because there were no computers in those days, the identification mark allocated to an applicant was placed on the certificate with a rubber stamp. Since a brand could become very confusing if the letters are rotated through varying degrees (see above), many farmers thought that the registration clerks made stupid mistakes when the certificate was issued and that the rubber stamp was merely held in-correctly by the particular clerk. The farmer then simply "corrected" the perceived mistake made by the clerk and turned all the letters upright when branding the animal. By doing that, he immediately duplicated the brand of another livestock owner.

Ninthly, as far as owning branding and tattooing equipment is concerned, in South Africa it is allowed that each livestock owner may brand his / her animals with branding irons manufactured either by themselves, or bought from various manufacturers. There is no control over issues like uniformity of letter sizes, training, the owning of illegal branding irons and animal welfare. It is even possible for any stock thief to own a

complete set of branding irons and tattooing equipment, thus making it possible to reproduce any of the thousands of registered brand marks on any unmarked animal.
Finally, an issue that was raised many times by the farmer's organisations arguing against a national compulsory branding system in the RSA was that subsequent owners of the same animal must brand the animal consecutively with each new owner's brand. In other words, the first owner brands the animal on the left hind leg, the second owner on the left front leg, the third owner on the right front leg and then if there is a fourth owner of the same animal, his/her brand must be placed on the right hind leg. The major concern with this consecutive branding was the damage to the hide. However, because consecutive re-branding is allowed, the complicating issue is that the thief can simply steal branded animals and place his/her brand in the next position, wait for the wounds to heal (or brand through a wet cloth) and just sell the animals as if they were his/her own. It is a major flaw in the South African system that more than one brand is allowed on the same animal.
As far as policing is concerned, it must be mentioned that the South African Police Service has specialised Stock Theft Units (STU's). These units (currently 62 in total) are placed around the country in strategic towns. The advantage is that these units are all specifically trained and well endowed with excellent equipment to solve livestock theft cases. Under normal circumstances the urbanised police investigators have little knowledge of finding clues specifically related to stock theft and how to deal with farmers. The farmers in turn prefer the STU's as they get to know the staff very well. This leads to mutual trust and friendship. Once the community and the police work together to solve the cases, the success rate in solving crimes climbs rapidly.
It is clear that even though South Africa has compulsory animal identification of all farm animals in place, there are problems that should be addressed. There are, however, valuable lessons to be learnt from their experience.

Namibia

The Republic of Namibia obtained her independence from South Africa in the early 1990's. The former South West Africa was a German colony up to World War I and after the war ended in 1918, the administration of South West Africa was entrusted to South Africa by Great Britain. After South Africa gained independence in 1961, this administrative control over Namibia remained in place. Because of this fairly long period that Namibia was administered by South African, most of the systems, processes, legislation, etc. show great similarities with that found in South Africa.
The identification of animals is compulsory in Namibia on commercial farms and was indeed compulsory long before the South African system was made compulsory. Communal farmers do not have to brand their

animals, but should they wish to sell an animal, or send it to the abattoir, it must be branded first. Individual communal farmers use the brand issued to a particular community and not that of the individual owner. The Namibian Registrar of Brands is placed under the jurisdiction of the Director of Veterinary Services. In the case of the traceability of meat, the control and administration of this system was placed in the hands of the Namibian Meat Board. All animals delivered to be slaughtered at any abattoir must be branded, whether they are from a communal area or from a commercial farm. The data of a particular batch of animals arriving at the abattoir are recorded and fed into a computer system run by the Meat Board. The meat is then labelled with a bar-coding system according to the captured information, i.e. owner, area of origin, date of arrival, date of slaughter, abattoir, carcass weight, etc. This information can then be used to trace-back any meat sold in Namibia or overseas to a particular owner. The European Union accepted these measures and Namibia is therefore allowed to export to the EU as well.

Botswana

It is known that the Republic of Botswana is in the process of implementing a microchip system for the identification of individual animals. The main purpose of this system is to enhance traceability of the animals to be slaughtered at the Botswana Meat Corporation's Lobatse Abattoir. The objective of this system is to ensure individual identification of cattle within the country in compliance with the EU Council Regulation EC1760/2000 and EC1825/12 which require that a computerised system be put in place to identify and register bovine animals, and label beef and beef products.

Speaking in Parliament during 2003, the Minister of Agriculture said that the Botswana Government has at that stage already spent more than P99 million (US$21 million) on the Livestock Identification and Trace-back System (LITS) since its inception. It was added that the money was spent on inserting the bolus into 807 600 cattle (mean cost of US$26.30 per animal). It was estimated by the Minister that the total cost of the project by the end of December 2003 would be approximately US$35 million. However, he added that the cost was likely to increase because of currency fluctuation. There is currently no legislation which forces farmers to insert the bolus into their animals, but it was suggested that the Government might adopt measures such as providing free vaccination only to cattle that have the boluses

It must be added that Botswana had a formal animal branding system in place before the recent microchip development. The branding of cattle as a system is still operational and it was compulsory long before animal identification became compulsory in South Africa. The system also features a district brand so that animals may be traced back to a particular area of origin.

Lesotho

Although there were attempts to get an identification system underway in the Kingdom of Lesotho on a number of occasions, an official, nationwide identification system apparently never really materialised. The marking of animals was in operation in Lesotho in the past and are still being done today by some farmers. However, the marks used, were not on an organised and sustainable national scale and it was not compulsory for farmers to register their brands and/or marks. Even today, individual farmers identify their animals according to tradition or with methods and marks that are either not recognised, are easy to change, and are also duplicated between various livestock owners.

During 1998, the Government of Lesotho commissioned a study of the agricultural situation and the related problems. This report was extremely comprehensive and a number of projects were identified, of which animal identification was the most important. During the past decade there was a dramatic increase in cross-border problems between South Africa and the Kingdom of Lesotho, as well as a dramatic increase in stock theft internally. The situation has deteriorated so badly that the theft syndicates sometimes kill herdsmen to prevent them from becoming witnesses. Animals are stolen at night and driven across the border into South Africa. The Basotho farmers then retaliate by going into South Africa and simply take those and sometimes other animals back to their country. This spiralling problem resulted in many meetings between delegates of the two countries. It must be said that the political will of the entire Lesotho Cabinet and Parliament to urgently solve the problems of livestock theft is a great support to those that have to implement the newly designed identification system. A further advantage is that the police forces of Lesotho and South Africa work together very closely and combined operations are often carried out. The biggest problem that remained was to identify the original owners when recovered animals had to be returned to their legal owners.

The senior author of this paper was appointed by the Lesotho Department of Livestock Services to design and implement a national identification system. The design was finalised and accepted by the Project Coordinating Committee during May 2003 and the legal consultant has drafted the proposed regulations. The system accepted by Lesotho is to a very large extent similar to that proposed for Malawi (Campher & Njunga, 2004). The same design was used, as the objectives of the project is exactly the same, i.e. curbing livestock theft, movement control and traceability in the short term, and livestock improvement and food security in the longer term (Campher, 2003).

The tendering process for appointing software developers for the data capturing system, as well as the supplier of the hardware is currently underway. The implementation in one of the districts will start later in 2004.

Swaziland

The Great Stock Brands Act of 1937 provided for the identification of livestock in the Kingdom of Swaziland. To this day, livestock identification is compulsory only for commercial farmers on title deed land. There is no system in place for communal farmers on the so-called Swazi National Land (SNL). Commercial farmers may not sell any animal unless they are branded according to the legislation. The Great Stock Brands Act was repealed when the King and the Parliament of Swaziland approved the passing of the Livestock Identification Act, 2001. A lack of government funding and donor contributions has thus far prevented the actual design and implementation of the administration and infrastructure needed for the functioning of the system. According to Thwala (personal communication, 2003), it is envisaged that the FAO will be approached with a request of registering a TCP to acquire the necessary expertise of a suitably qualified and experienced consultant on livestock identification and registration systems. This system is urgent as livestock theft, straying of animals and cross-border movement between South Africa and Mozambique are on the increase.

The current situation is that each of the Dip Tank Veterinary Assistants (DTVA) has to keep a register in which the details of the owners, village, numbers of animals, and traditional identification marks must be recorded. In the event of the sale of an animal, the particular Dip Tank Committee, consisting of farmers, must assist with the positive identification of the animals as the lawful property of the seller and it must issue a so-called "no objection" to the animal being sold. The DTVA may only then issue a Stock Removal Permit (SRP). Whilst a copy of this SRP remains with the Dip Tank Committee, the original must accompany the animal(s) during all stages of the transfer to the new dip tank area. Upon arrival at the new dip tank, the new DTVA in charge will again record all the details regarding the arrival of animals into his / her register. Importation of animals may only take place if the animals are positively identified by means of a brand or tattoo.

The Swaziland Livestock Identification Act (2001) has a number of stipulations that will eventually cause the same problems as found with the South African system. These include:

- no provision for identifying country, district or area have so far been made in the system;
- that livestock owners will be allowed to brand and or tattoo their animals themselves;
- the owning of identification equipment; and
- the major problem, the re-branding of animals by the consecutive owners of the same animal.

However, an important aspect of the Swaziland animal identification legislation that will greatly assist in solving livestock theft cases is that all butchers, abattoirs, speculators, dealers and foreign traders must keep a register of all transactions. Complete details of the owner from whom the animal was bought, any identification marks, and the transaction itself must be in the register.

The biggest advantage that Swaziland has, is the extremely well-designed, efficient and operational population registration and crime reporting system. This system was developed as a close partnership between the Government of Swaziland and one of the largest software developing companies in Africa. It can probably be considered as the best of its kind in the SADC region.
The population of Swaziland is now being registered from birth. As soon as a birth is registered, an identification number is allocated to that particular child. At age 16, the fingerprints (with an automated fingerprint identification system called Print Track), the photograph (with a digital camera) and the complete personal details of the applicant is taken and recorded on the computer. The fingerprints (all ten digits), the photograph and the personal details of each person are then encrypted and converted to a 2-dimensional bar code. The unique key to the entire population register is the identification number. Once the registration process is done, a top quality identification card is issued. This id-card contains many high security features and can not be forged. On the id-card appears the photograph, the personal details, as well as the 2-dimensional bar code which may at any time be scanned to reveal the fingerprints, and all other details. The most important aspect of this is that the 2-dimensional bar code can be recognised by computers. This encrypted low volume data storage technology in pdf-format is freely available. Once a reader reads the bar code, the person's details, picture and fingerprints appear on the screen.
As far as livestock owners and their registration are concerned, this efficient population register will make it possible for the Ministry of Agriculture to simply link with the Ministry of Home Affairs to check on an applicant's details and issue him/her with another card bearing the details of the animal identification mark, dip tank, and other information on the new card. This card will identify the animals in a person's possession. Also, should any fingerprints be found at an illegal slaughtering scene (on a knife for instance), it will be very quick to trace the person or persons involved with the livestock theft.

Mozambique

According to Ramsay (2004, personal communication), Mozambique was given the computer system used by the South African Registrar of Brands. The important difference from the South African system being that there is provision for a country mark and the Mozambican system will also provide for district, village, dip tank and the owner's information in order to enhance trace-ability to origin of birth. There is a pilot testing under way in one of the districts. Unfortunately the former South African Registrar of Brands could not supply any details regarding important aspects such as the printing of registration certificates, security features in the system, transfer of ownership, consecutive branding by the new owner of the animal, and many other important aspects involved with

the implementation of a new animal identification system. Attempts to obtain more information regarding this pilot test from Mozambican officials have failed.

Zambia

Zambia has had a Brands Act since 1913. The system provides for the use of two alphabetical letters to indicate the district of origin and then two numerals to indicate the individual owner. As is the case in South Africa, consecutive branding of the same animal upon transfer of ownership is allowed. It is compulsory to brand all cattle in Zambia. Stud breeders may, however, get exemption from this stipulation.

Zimbabwe

The Livestock Identification Trust manages the identification of livestock in Zimbabwe. Unfortunately at the time of the writing of this paper, more information on the identification system used in Zimbabwe was not available. It is known that Zimbabwe also has a system of district and individual brands. As far as could be ascertained, it is compulsory to brand all cattle in Zimbabwe.

Other SADC countries

In spite of a request for information sent to Tanzania, Angola, the Seychelles, Mauritius and the Democratic Republic of the Congo, very little regarding animal identification systems in these countries was forthcoming. It is suspected that the former colonial governments may have promulgated legislation in this regard, but whether the systems were sustained is unknown. The current situation in Malawi is reported on by Campher & Njunga (2004).

Conclusion

Most of the SADC member countries have legislation controlling the identification of animals, or are in the process of establishing legislation and designing new systems. Unfortunately the systems are often not maintained, or lacking in important aspects.

The decision by the Council of Ministers in 1999 to embark on a route of establishing a uniform system for proper animal identification, trace-back, movement control and the collection of production data in the SADC region is an important step towards enhancing intra-regional trade and to curb rampant stock theft.

It is important that each of the countries should take a serious look at the problems with their current systems. All too often thieves that go free because of improper control, poor documentation and above all, a lack or proper policing.

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Animal identification and recording systems in the Southern African Development Community (SADC): 2. Proposed I&R system for Malawi

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Summary

The design of the Malawi animal identification and recording system (I&R) has been completed and the supporting legislation was drafted. The I&R system provides for the identification and trace-back of any animal back to its original owner, traditional authority, district and country. It is based on the branding of large stock with a hot iron and tattooing of small stock in the ears. A pilot field test will be conducted in the near future. The supporting legislation will pass through parliament before the end of 2004, where after the I&R system will be implemented.

Key words: animal, branding, identification, Malawi, recording, SADC countries, tattooing, trace-back, veterinary control.

Introduction

Livestock theft both within Malawi and across her unfenced porous borders (shared with Mozambique, Zambia and Tanzania) is reaching problematic proportions. Livestock theft is a central element in a complex series of interconnecting factors, which undermine the social and economic security of the local community and society in general. Although poverty may be implicated as the basis of some livestock thefts, there are definite indications that organised stock theft syndicates are involved on both sides of the border. Livestock theft has a serious negative impact on poverty, especially when animals belonging to the poorer livestock owners are stolen (Campher, Njunga, Campher, Chinula & Chibwana, 2003).

As far as animal identification and recording (I&R) is concerned, Malawi is currently at a disadvantage when compared to countries like the Republics of South Africa, Namibia, Botswana, Zimbabwe and the Kingdoms of Lesotho and Swaziland which either have systems in place, or are busy implementing I&R systems in their respective countries.
The Government of Malawi (GoM) realised that the full implementation of a complete livestock identification, trace-back, recording and data information system requires heavy financial investment either by the GoM itself, or from donor organisations. The GoM has already recognised the fact that the pre-requisite to the system is appropriate legislation, which was inadequate or mostly non-existent. For this reason a Technical Co-operation Project (TCP) was initiated with the aid of the Food and Agricultural Organization (FAO). In summary, the aims of the TCP was to design an I&R system and to draft appropriate legislation in support thereof to

- effectively remove stock thieves from society and thus reducing stock theft significantly;
- assist in curbing illegal cross-border movement of animals;
- have an easily identifiable identification mark to enable proper movement control in case of disease outbreaks;
- enhance animal health programmes;
- serve as the basis for a future genetic improvement programme; and
- allow for production / marketing data to be used in food security strategies.

The Malawi I&R system

The design

At various meetings on SADC level it was proposed that each country should have a unique identifying mark by which animals from that country can be identified. Should there be an area in a neighbouring country where a particular disease is prevalent, the authorities can easily identify animals from such a country and take the necessary steps to destroy the animal, quarantine it for further tests, or return it to the country of origin. In the case of Malawi, the image of the rising sun will be used (see Figure 1). In the case of bovines and equines, the left front leg will be used to identify the country of origin of the animal. In the case of small stock species (goats, sheep and pigs) the animal's right ear will be used.
Each of the 28 districts in Malawi will be identified according to the same alphabetical letters used in the current vehicle registration system. This will ensure that there is no confusion amongst livestock owners, veterinary officials, traders, police, and others. These alphabetical letters identifying the district will be placed below the country mark, on the front left limb of large stock or in the right ear of small stock.
To further distinguish between animals within the district, each of the Traditional Authorities (TA's) will be identified according to an assigned numerical character. This numerical character, for instance 6, will be

Figure 1. Image of the rising sun to be used to identify all Malawi animals

placed above the three alphabetical characters used to identify the original owner of the animal. With a system of using three different alphabetical letters, a total of 17 576 different combinations are possible.

Registration on the I&R system

The Registrar of Animal Identification, in terms of the envisaged legislation, will register every livestock owner in Malawi. The livestock owner will then be compelled to identify all their livestock according to the allocated identification mark within a certain period.

Since there are instances where livestock owners do not actually live in the village where the animals are kept, such animals are then cared for by herdsmen or herdboys. It is proposed that these full-time employed herdsmen must also be registered on the I&R system. Too often some of these people are involved in livestock theft syndicates. By being a registered herdsman, the person will realise that his/her information is now on a central database and if caught as a livestock thief, will result in losing his/her registration. Thus making it very difficult to find another job with a different livestock owner.

Another group of people who are often involved in livestock theft syndicates are those involved in trading animals for financial reasons on a regular basis, commonly known as traders. All traders, i.e. speculators, feedlot owners, butchers, abattoir owners, agents, etc. will also be registered on the I&R system. This will assist with the legalisation of the trading profession and if involved in any livestock theft case, such a person will lose his/her registration and can never be a trader again.

To prevent the illegal marking of any animal, only suitably trained, approved and registered livestock marking operators will be allowed to own branding irons, ovens, tattoo pliers, tattoo letters, immobilisers and other equipment used in the process of marking an animal. These trained livestock marking operators will also be registered on the I&R system.

Once all livestock owners, herdsmen, livestock marking operators and traders are all registered, there is no reason for any other person to be in possession of animals without an identification card issued by the

Registrar of Animal Identification. Should any person be herding, keeping or transporting animals without a valid identification, it will be *prima facie* proof of a crime being committed.

The registration process

All the livestock owners, herdsmen, or traders will have to visit an animal identification registration office in his / her district to be registered on the national I&R database. Should a livestock owner have animals in more than one TA in the same district, he / she will not have to register an identification mark for each of the TA's in question. However, should he / she own animals in completely different districts, an identification mark for each of these districts and the relevant TA must be obtained? This is to meet the requirement of improved animal health movement control.

The personal details of the applicant (such as name and surname, gender, TA, district, village, dip tank, number of animals of each species on day of registration, etc.), the person's photograph and the fingerprints of all ten digits are captured directly onto the computer of the district office. Each applicant will choose three secret questions from a list of ten. The secret answers to these three chosen questions will be captured on the I&R system. Thus allowing the police or any other authorised person to identify a livestock owner, herdsman or trader who may for some reason not be in possession of his / her id-card by means of a phone call to the central database.

A temporary animal identification registration certificate is immediately issued and this must be returned when the owners, herdsmen or traders return to fetch the centrally issued identification card and the permanent registration certificate.

Security in the I&R system

All the computer and administrative staff in the various district offices and the central office will only have access to the I&R system through fingerprint identification. The I&R will not allow any unauthorised person to operate any computer without prior identification. This not only ensures that unauthorised persons gain access to the system and captures the data of known criminals, but will also leave a clear track of which operator did what amount of work, and for which applicants.

At the end of each working day, the data captured in the district offices are sent through to the central office in Lilongwe. In the central office all data are verified, encrypted and stored on the mainframe computer. The encrypted data is then transferred to the bureau where the high security identification cards and permanent registration certificates are manufactured in a safe and secure environment. Both the registration certificate and the id-card will be authenticated with security features, including possibly 2 dimensional barcoding.

The id-cards and certificates are then returned to the districts where they will be issued to the applicant only upon again identifying the applicant as the true owner of the registration on the fingerprint identification system.
Either the id-card or the certificate must be shown to the registered livestock marking operator before the latter will be allowed to mark any animal. The number of animals marked for a particular owner will be recorded in the livestock marking operator's register.

Administrative infrastructure

The I&R system infrastructure will consist of the central office situated at the offices of the Director of Animal Health and Livestock Development (DAHLD) in Lilongwe. Each of the 28 districts will have at least one satellite data capturing office. The main database of the I&R system will contain all the relevant information of the registered livestock owners, herdsmen, traders, livestock marking operators and every authorised staff member.
The DAHLD office in Lilongwe is central to the system and will be able to manufacture and issue the high security id-cards and the permanent registration certificate, as well as distribute the said documents to the various district offices, check and verify the machine readability of all documents showing the 2dimensional bar code and control the entire I&R system and the distribution of information for other agricultural projects, food security programmes, grazing and pasture management, livestock improvement, agricultural strategy and policy purposes, etc.

Marking equipment

Every piece of equipment used to identify an animal will be uniquely identified with a numbering system. Hence, each set of branding irons, branding oven, tattoo pliers, immobiliser, or any other equipment issued to a particular registered marking operator, can be identified as the property of that particular person. The new regulations promulgated in terms of the legislation will declare illegal the ownership of any non-officially issued branding irons and tattooing equipment by any person, other than registered livestock marking operators. By doing this, stock thieves will not be able to have access to such equipment, unless stolen from a registered marking operator. A further important aspect is that a unique set of numerals and letters for use in Malawi exclusively will be designed. This design will differ from the irons used in neighbouring countries and Malawi animals will carry a mark made with letters and numerals designed in a specific unique way. It will not be possible to use irons not manufactured by the specific supplier on any animal in Malawi without the authorities having knowledge of this.
To address the issue of animal welfare, only upon successful completion of a comprehensive training course, livestock marking operators shall be. During such a training course all animal welfare aspects pertaining to the marking of animals in the most humane way, using an immobiliser and with the necessary medication at hand, will be taught to the trainees.

Record keeping

By allowing only registered operators to mark animals, it will ensure the keeping of records of all animals belonging to a certain livestock owner, so marked. Only the mark shown on the official registration certificate and/or id-card will be allowed to be placed on any animal and this document must be presented to the operator before he is allowed to place a mark on any animal. Through the system of record keeping of all animals branded by any particular marking operator, the district agricultural officer will know exactly how many animals each livestock owner under his/her jurisdiction owns.

In the case of the transfer of ownership of an animal, the new owner will not be allowed to mark the animal with his/her identification mark. Any animal may only be marked once in its lifetime. Upon transfer the owner of the animal will visit the office of the TA to obtain a transfer of ownership document to be handed to the new owner. The TA will delete such animals from the TA register and complete the transfer document. The new owner is obliged to visit the TA office where the animals will be moved to. There the details of the animals will be entered into the register of that particular TA. The new owner is also obliged to keep all transfer of ownership documents. Should the animal be sold again, the same transfer document will again be given to the third owner. This means that as long as an animal is in the possession of its original owner, a so-called animal "passport" will not be issued. Once the animal is sold, the "passport" is issued by the TA and the passport will accompany the animal for the rest of its life time. In short, if any animal is found in the possession of any person, such a person must either produce the registration certificate on which the identification mark is shown, or alternatively the transfer of ownership document ("passport").

DNA analysis as a back-up system

The use of DNA-analysis as final indisputable proof of a particular animal will also be incorporated into the I&R system on a voluntary basis for valuable animals. The storing of the hair samples according to a well catalogued system will be done within Malawi itself. This would entail keeping two samples in two different locations to ensure that a catastrophe like fire, flooding or theft will not destroy all the samples. Should a theft occur and any tissue sample of the animal can be obtained, the matching hair sample and the tissue sample will be analysed to determine beyond reasonable doubt the original ownership of the animal in question.

Legal analysis and draft legislation

Although several pieces of existing legislation deal with animals, animal products, diseases and even the theft of animals, there is no dedicated and specific law in regard to the identification and registration of animals, and in particular livestock, in Malawi. The existing legislation were analysed by international and local legal consultants and it was concluded that a dedicated legal framework for the proposed I&R system that will fit into the present legal environment, be drafted.

The proposed new Animal Identification and Registration Bill, 2003 was presented to a national workshop of stakeholders and only minor revisions were suggested. After these changes were made, the Bill was presented to the legal department of the Ministry of Agriculture and Food Security. Currently the bill is being prepared for Parliament by the Department of Justice and it will probably pass through Parliament after the May 2004 general elections.

Conclusions

The design of the Malawi I&R system has been finalised and the legal support has been drafted. A field testing phase will be conducted soon after the general elections in May 2004. Upon completion of the final report donor organisations will be approached in order to find support for the full implementation of the I&R system. This implementation will be done district by district. A comprehensive media plan has been drafted and the full support and cooperation of the livestock keepers will be obtained.

It will soon be possible for Malawi to trace back animals to the origin, whether it is from a neighbouring country, or from any district and village situated within the country. Stock thieves will be apprehended and prosecuted more successfully. Animal health movement control will be on a much higher level and finally comprehensive data on animal numbers and production will also enhance livestock improvement programmes and food security planning.

The Government of Malawi has taken the lead in the eastern sector of SADC and she will support all similar efforts in the neighbouring countries.

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Livestock identification and recording: The Namibian experience

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Summary

A brief historical account of livestock identification and recording in Namibia is given. A meat quality assurance scheme (FAN Meat) was introduced in the late 1990's which had a traceability component based on cattle brands. It was found that brands cannot be used for traceability and an ear-tagging system has been introduced. A voluntary livestock recording scheme has also been initiated; this will run on the back of the identification and traceability system. It is considered that the additional cost of the traceability system is economically feasible given the total value of Namibia's meat industry.

Key words: South African National Beef Cattle Performance Testing Scheme, traceability, FAN Meat Scheme, Bar-coded ear tags, standards.

Introduction

The practice of marking livestock in Namibia started in German colonial times (Namibia was a German colony from 1884 to 1915). The German administration initiated a stock brands register and cattle were branded with marks identifying their owners. Following the First World War, German Southwest Africa (as Namibia was then known) came first under South African military administration, and once the territory was given to South African protection under a League of Nations mandate, a new civilian administration was instituted in 1920. Under the civilian administration, an ordinance requiring the branding of white-owned cattle was passed in 1921, followed by an Ordinance for 'native' cattle in 1923. A new Ordinance was passed in 1931 for white-owned commercial cattle and it was some years after Namibia's independence that a unified law for branding all livestock in the country (the Stock Brands Act of 1995) was passed.

On the side of livestock recording, Namibia has a history of attempts at recording the performance of livestock for selection purposes.

The South African National Beef Cattle Performance Testing Scheme was initiated in 1980 and implemented in Namibia, which was at that time administered by South Africa. The objective of the scheme was to attempt to characterise genotypes of breeding stock by measuring weight

gain, feed conversion, fertility etc, and giving farmers yardsticks by which to measure their stock – other than by appearance alone. Farmers participated voluntarily by sending breeding stock to government testing stations for a 90-day testing period during which animals were evaluated. Individual identification of these animals was the key to the system.
A similar performance-testing scheme was designed for on-farm trials; the on-station trials have now been phased out.
During the 1960's, a 'postal recording system' was introduced to which farmers could subscribe. This was designed to measure farmers' financial performance, solvency, returns to investment, etc. A part of this was biomass determination so that returns per kg produced could be determined. There was no direct need for keeping records of individual animals, but obviously farmers who did this could participate more effectively. The system has been modified over the years, but still continues.
The Namibian Stud Book Association runs a complete individual recording system for all registered stud animals in the country, keeping records of each animal's growth performance, reproduction, movements and slaughter. The system is fully computerised and runs on web-based software.

The present situation

The present situation with regard to livestock identification and recording in Namibia arises from two separate needs that were articulated almost at the same time:

- *Identification for traceability*: better identification methods to meet traceability requirements of the EU and certain South African retail and catering chains became a clear need shortly after the beginning of the present decade
- *A new record-keeping system*: commercial farmers began searching for a computer-based system that would help them keep detail records of individuals' performances on a nationwide, standardised basis

The drive for traceability

The need for meat to be traceable back to the animal from which it originated and then back to the various links in the production chain through which the animal passed, was occasioned by various 'food scares.' The BSE scandal probably played the greatest role in triggering the design of traceback systems, but other 'triggers' such as *E. coli* O157:H7, the use of growth stimulants and the fear of other toxic residues in meat also played a key role.
Namibia, being an exporter of quality beef to the European Union (Namibia has a 13 000 mt annual quota in terms of the Cotonou Agreement) was not untouched by the drive for better traceability. In addition, various commercial clients in South Africa were also insisting on product traceability.

Assuring a better product: enter the FAN Meat Scheme

Some key role-players in the Namibian meat industry began to realise as early as the mid-1990's that Namibia needed to put in place some kind of quality assurance scheme for its meat industry if it was to continue to access premium markets. The 'farm-to-fork' approach had already been emphasised in Britain with the advent of Farm Assured British Beef and Lamb (FABBL) and it was felt that Namibia should put a similar scheme in place.

After much negotiating between stakeholders and government, the FAN Meat Scheme was codified in a comprehensive manual and approved by the Namibian Cabinet in 1999 with the Meat Board of Namibia mandated to manage the Scheme. Inspection and certification is the responsibility of the Directorate of Veterinary Services of the Ministry of Agriculture, Water and Rural Development.

The FAN Meat Scheme puts in place a set of voluntary standards covering farm management, record-keeping, livestock feeding, animal welfare, animal health, animal movement control, animal identification and animal transport.

The FAN Meat Scheme attempted to put in place a traceability system based on:

1. a computerised farm register
2. a stock brands register (brand codes were coded based on districts, allocated uniquely to individual farmers, and kept on a computerised register, linked to the farms where they were in use)
3. endorsement of brands on movement permits (veterinary movement permits are required for all livestock movements; when a movement took place, the farmer would endorse the brand symbols of the animals being moved on the permit).

The Namibian Stock Brands Act of 1995 made the branding of cattle compulsory; brands normally consisted of 3-character codes where the first character designated the district and the second two identified the farmer. These codes were computer-generated and were stored on a computerised register against the name of the owner of each brand (the farmer).

Under the FAN Meat Scheme, a second register of farms was created, and the register of farmers were linked to the farm register. In other words, the two databases were linked to show the association between the brand owners and the farms on which they farmed. In some cases, two or more farmers might farm on one farm, or one farmer might farm on two or more farms. A query on any given brand code would instantly show the name of the brand owner and the farm(s) on which he/she farmed.

Traceability falters

Although the software and the permit system underlying the traceability system were theoretically very good, the system foundered on a single factor: the use of livestock brands. The reasons for this are as follows:

1. The brand identifies the owner, not the animal. For traceability to be meaningful, the individual animal must be identified.

2. The brand mark itself was often not readable. This read to confusion when endorsing brand marks on movement permits; this involved a lot of guesswork and the symbol noted on the permit and the (often unreadable) mark on the animal often did not match.

Efforts were made to encourage farmers to brand more clearly, but these were unsuccessful. Even the clearest brand may be unreadable through a winter haircoat. The final straw came during an inspection by the EU Food and Veterinary Office which noted the deficiencies in a traceability system based on branding.

The challenge was thus to find a means of livestock identification that would clearly and unambiguously identify the individual animal.

Stakeholder discussions were intense and lengthy. Identification methods rejected were:

- *Tattoos*: poor readability.
- *Tail tags:* poor readability; non-permanent
- *RFIDs*: both the microchips and the electronic infrastructure they require are too expensive
- *Bar-coded ear tags*: electronic infrastructure expensive, but could be considered as an adjunct to other methods

Visual ear tags were accepted as being the most cost-effective method for use in Namibia; a clear set of characters of appropriate size laser-printed on tags would give good readability (within seconds at a distance of 1-2 metres).

Ear tag standards

A set of standards for cattle identification was agreed on. These standards would include:

1. The means of identification should not damage or contaminate the meat or hide of the identified animal.
2. Once an animal is in a head clamp, identification should take no more than 30 seconds to apply, pose no undue risk to the operator and cause minimal discomfort or danger to the animal.
3. The means of identification used should not cause pain or discomfort to the animal once in place.
4. Identification must be readily readable from a distance of one to two metres.
5. The means of identification used should be of uniform quality and manufacture, and be produced by means that reduce the possibility of forgery or unauthorised duplication.
6. Ordering and distribution of identification devices must be centrally controlled.
7. The means of identification used must be tamper resistant and non-transferrable.
8. The means of identification must be durable and have a high retention percentage.
9. Identification codes shall be in alphanumeric form for ease of recording.

With these standards in mind, a black-on-yellow laser-printed twin (male-female combination) tamper-proof plastic ear tag was agreed upon. They would be printed with a composite code that would contain two parts: one which identifies the birth farm, and one which identifies the animal.
Farmers may tag animals at any point in time, but they must be tagged before leaving their birth farms. Many farmers have undertaken to tag at birth in order to take advantage of a new livestock recording scheme that is under development (see below).

Making traceability work

Identification is only one part of a traceability system. A 'paper trail' is required to record the movements of identified animals. Under the new system about to be fully implemented in Namibia, departures of each animal will be recorded at 'exit points' (on farms, at auctions) on an official register. At 'entry points' (farms, auction pens, abattoirs) the tag numbers of arrivals are recorded.
Movements between exit and entry points are further recorded through endorsement of veterinary movement permits.
When such permits are received (at present on a monthly basis) at district state veterinary offices, the identification of individuals will be entered on a computer system. Access will be via internet connection.
Although the system of manual registers has been developed, the computer software (to be integrated into the existing system of farm registers, etc) is still under development.
The system is now implemented on a voluntary basis (several hundred farmers have procured tags) and will compulsory from early next year.

Small ruminant identification

A new regulation has been promulgated under the Stock Brands Act making provision for sheep to be identified with ear tattoos or ear tags bearing the owner's approved brand symbol. This has not yet been enforced. There are doubts about the readability of tattoos in dark-eared sheep.

Livestock recording has a bright future

Namibia's two agricultural unions – the Namibia Agricultural Union (NAU) and the Namibia National Farmers' Union (NNFU) have requested the Meat Board of Namibia to help design and finance a livestock recording system which will be open for use by any farmer who wishes to participate. The system will be based on a computerised database with a web interface, and will make provision for individual performance recording (weight gains, health, movements, slaughter weight and carcase grade, etc). With the advent of an official ear-tagging system and the allocation of individual identification, this recording system can easily "piggy-back" on the official system.

The Bottom Line

Trying to separate the exact costs of Namibia's beef traceability scheme is difficult due to the fact that its administration and enforcement is so closely entwined with existing elements of the veterinary control system. The farm register system will simply be absorbed into the farm inspections normally carried out by animal health inspectors of the Agriculture Ministry. The movement permit system already exists; instead of writing the stock brands of transported stock on the permits, they will be endorsed with ear tag numbers.
However, there are "new" costs associated with the scheme, and these are given in table 1.

Table 1. "New" costs associated with the scheme.

Item / Description	Cost (US$)
Initial Investment by Industry	
Software development	114 000
Total	114 000
Recurrent Costs	
Ear tags: 300 000 animals annually at $0.70 / tag	299 000
Administration (salaries)	40 000
Stationery	10 000
Total	349 000

Veterinary Services annual running costs amount to some USD 8 million p.a. This includes all services rendered in the livestock sector.
Total earnings from the meat industry come to over USD 150 million annually.
The cost of running a full traceability system for beef exports is thus a small percentage of total earnings.

Conclusion

The Namibian meat industry, in collaboration with the country's Veterinary Services, has designed a traceability system that is workable and affordable for developing countries. The system is still in its infancy, but there is optimism amongst Namibian farmers and industry leaders that it can be effective.

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Cattle identification systems and their impact on livestock industry in Thailand

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Introduction

The identification system developed in Thailand is mostly concerning cattle. The cattle identification system has been used for at least 48 years in the country, associated with the artificial insemination system. The first cow conceived with artificial insemination was in September 1956. (Sukhato, 1996). Since then, a system has been in place which has allowed to trace back the origin of the dairy cows in the system. For beef cattle and buffalo, this system can also be used but with some modifications. From that origin, the system has been developed from a manual to computer database system.

Due to the fact that there is no single organisation for animal identification system there are more than one database used by several authorities. In this report, the discussion will be based on the details of the identification systems, pros and cons and their impacts on cattle industry in general.

Livestock statistics

Numbers of livestock in Thailand for the last 10 years are shown in the Table 1. Since 1993, the number of animals tend to decline, except for goats, ducks and chickens. This trend is following the fact that chicken exporting industry is growing every year. The number of goats and ducks did not change dramatically. The decline of the number of other livestock in general might result from a significant number of people moving to work in the industry, for example: electronics, or other hi-tech industries. The number of cattle is the sum of dairy and beef cattle. This figure also decreases by about 1.5 million cattle in 10 years' time.

The number of livestock farms was almost 2 million in the year 2003 (Table 2). When compared to the overall country total (Thai Census 2004: *www.mahadthai.com)* at about 18 million, the families in livestock business are almost 11%. Furthermore, in 2002 Thailand exported livestock products for a total value of more than US$ 1 billion (Livestock Production Export Statistic, 2002: *www.dld.go.th)*. This means that people working in this sector are very significant to the country's economic system.

Table 1. Livestock statistic (by animal types) from year 1993 – 2001 (Livestock Statistic, www.dld.go.th).

	Animals								
Year	Elephant	Horse	Cattle	Buffalo	Swine	Goat	Sheep	Duck	Chicken
1993	2 665	18 047	7 472 573	4 804 146	8 569 126	151 860	110 465	21 778 395	138 832 027
1994	2 502	14 032	7 637 350	4 224 791	8 479 400	141 076	90 508	21 811 815	129 997 098
1995	2 692	16 875	7 609 068	3 710 061	8 561 921	132 400	75 329	18 896 635	111 648 510
1996	3 514	12 003	6 225 221	2 711 737	8 707 887	118 829	40 900	21 400 375	144 579 428
1997	2 180	14 672	5 594 808	2 293 938	10 139 040	125 262	41 926	21 829 896	164 685 842
1998	2 118	11 322	4 863 373	1 951 068	8 772 275	130 904	40 404	19 748 077	155 324 646
1999	2 568	7 350	4 918 396	1 799 606	7 423 101	132 845	39 485	22 330 123	169 632 507
2000	2 172	8 596	5 208 541	1 702 223	7 761 056	144 227	37 312	27 884 041	189 341 110
2001	2 681	8 039	5 571 283	1 710 095	8 203 270	188 497	42 720	28 448 399	214 979 081
2002	2 563	8 103	5 908 625	1 617 358	6 989 152	177 944	39 326	25 034 011	228 760 326

Table 2. Livestock and Farmer Statistics of the year 2003 (Statistic at 1st Jan 2003) (Livestock Statistic, www.dld.go.th).

Type of Animal	Number	Number of farmer (by family)
Dairy Cattle	380 203	20 101
Beef Cattle	5 916 323	993 688
Buffalo	1 632 706	461 152
Swine	7 815 534	317 564
Goat	213 917	23 894
Sheep	42 883	5 538
Elephant	2 839	1 303
Horse	7 137	2 007
Deer	5 810	118
Camel	33	11
Total number of farmer family	1 825 376	

Identification system

Department of Livestock Development's cattle identification system (DLD)

Dairy cattle

The system used by the Department of Livestock Development (DLD) is mainly based on dairy cattle. At present, it is working on a computer database system. The system starts with farm registration, which consist of 4 digits as a running number. When combined with the other two codes of 'province' and 'amphur' or district code (using standard code from "Communication Authority of Thailand: CAT") another four digits are used as a prefix (Table 3). The province ID code consists of two digits, the first is for the region code as in Table 4 and the second one is for the running number of the province in that livestock region. The number of provinces will never go beyond 9.

For cattle registration, the numbering system consist of 8 digits as follows.

$$X_1\ X_2\ Y_1\ Y_2\ ZZZZ$$

- The first digit (X_1) is the Livestock Region ID code (as in Table 4).
- The second digit (X_2) is the Province code of that region (as in Table 3, all provinces in that table are from region 1).

Table 3. Sample of Province and Amphur ID of Livestock Region 1 (Buaban and Poopetch, 1994).

Province ID	Province Name	Amphur ID	Amphur ID
0	Bangkok	01	Pranakorn
1	Samut Prakarn	01	Maung Samut Prakarn
2	Nonthaburi	01	Maung Nonthaburi
3	Pathumthanee	01	Maung Pathumthanee
4	Ayuthaya	01	Phranakorn Sriayuthaya

- The third and fourth digit (Y_1 and Y_2) refer to the year in Buddhist Era (B.E.) by using only the last two digits of that year: i.e. 2547 B.E. will be 47.
- The last four digits (ZZZZ) refer to the number of a calf born in that province in the year concerned.

For example, a calf which was born 599th in the Ayuthaya province in the year (2547 B.E.) would have an ID of '14470599'. This system assumes that there will be no more than 9 999 new born calves in any province annually. The new born calf will be ear tagged using brass ear tag and recorded in a system as a member of a dairy farm.

Beef cattle

The beef cattle identification system is similar to that of dairy cattle. However, the first digit will not be a number, it is replaced by an alphabetic code as in the second column of table 4: i.e. region 1 will be A. So, if a beef cattle calf was born as 2 990 in the Pathumthanee province this year, would have a number of 'A3472990'.

However, since the total number of beef cattle is so high, there would be more than 9 999 calves born in a province annually. So, the running number is allowed to go beyond 9 999 limits by using both sides of brass ear tag. The first 5 digits will be on one side and another 4 will be on the other side. Nevertheless, beef cattle registration is used in a limited scale because there is a huge number of beef cattle compared to the number of people working in the DLD office.

Bureau of Disease Control and Veterinary Services (BDCV) System

The main purpose for animal ID system of the Bureau of Disease Control and Veterinary Services (BDCV) is the tracking of animal movement. Due to the fact that this bureau is in charge of veterinary disease control, they will use their own system. The registration begins when an owner of an animal informs an officer that he will want to move his livestock.

Table 4. Livestock region code (9 regions in total).

Region ID		Artificial Insermination and Biotechnology Research Center Name	Country Region
Dairy	Beef		
1	A	Saraburi	Central
2	B	Chonburi	East
3	C	Nakorn Ratchasima	Northeast (Lower part)
4	D	Khorn Khen	Northeast (Higher part)
5	E	Chiengmai	North
6	F	Pitsanulok	Central North
7	G	Ratchaburi	Central West
8	H	Surat Thanee	South (Higher part)
9	I	Songkla	South (Lower part)

According to the law, the authority must issue a document which will show the details of the animal: type, number, origin and destination including the veterinary record. An ID system must be always utilized. However, there are two type of animals: one already has an ID and the other is without any.

The bureau will use any IDs which existed on an animal to identify it. If there is no ID, the office will use hot branding directly on the animal body. The system is working in this way to trace all animals legally.

Division of Animal Husbandry System

The main objective of the Animal Husbandry Division is livestock breeding improvement. Their system is mainly used internally. The identification system consists of 8 characters formed by 5 digits on the left and 3 alphabets on the right (Vitoonpong *et al.*, 2002), as follows:

XX YYY ZZZ

- First 2 digits (XX) on the left refer to the year in B.E. and the other 3 (YYY) refer to the running number of the animal, born in a particular farm in that year.
- The last 3 characters (ZZZ) refer to the farm or office that is registered in the system.

For example, if an animal has ID of '43008TAK' means that this animal was born in the year 2543 B.E. in the eighth order of TAK farm.

This system has been applied to all livestock species including, cattle, pig, sheep, goat etc. excluding poultry.

Poultry breeder

The ID system for poultry is reserved only to registered breeders. The system consists of 5 characters as follows:

AA YYY

- The first two (AA) refer to the name of the farm in English alphabet and the last 3 (YYY) is a running number of a bird born on a farm that year. For example, 'KB850' will be the number ID of the breeder bird which was born as number 850 in the farm KB in that particular year.

This system is used only for one year and a new re-run is done every year. The record books are changed every year and must be separate for any particular type of poultry. This system is appropriate only for control of a small amount of birds within confined space.

Dairy Farming Promotion Organization of Thailand (DPO) System

The Dairy Farming Promotion Organization (DPO) is the other official organization directly involved in dairy cattle industry. All activities concerning farmer and dairy cattle are similar to that of Department of Livestock Development (DLD).
The ID system of dairy cattle is comparable to that of BBLP, DLD. However, due to the fact that the area of promotion is limited, the ID system is based only on the area of origin of the cow. Thus, the system code is somewhat different from DLD system as reported in Table 5, comprising 2 alphabets in English and 6 digits which indicate year and running number:

AA YY XXXX

- The first two characters (AA) are the code for the service area issued by DPO (Table 5).
- The following 2 digits (YY) are from the year in Buddhist Era (B.E.) by using only the last two digit of that year: i.e. 2547 B.E. will be 47.
- The last four digits (XXXX) refer to the cronological number of cow born in that service area and year.

For example, a cow with ID number 'ML422315' is a cow born as number 2 315 of the year 2542 B.E. in service area called 'Muak Lak'.
There are some more codes which are not mentioned here. For example, breed code i.e.; HF = Holstein Friesian, is the code used internally for database system reference to breeding program. This code will not be on animal ID.

As mentioned above, the ID systems that may be suitable to be used and compared nationwide are the ones of BBLP, DLD and DPO. The other two systems from BDCV and Division of Animal Husbandry are not suitable for extensive use. .

Table 5. Sample of area code used by DPO.

DPO center / Dairy co-op names	Code
Muak Lak	ML
Parkchong	PC
Patananikom	PK
Subkradan	SD
Praphuthabaht	PB
Nongmuang	NM

Comparison between the systems

The identification systems of BBLP and DPO have their own strengths and weaknesses. Table 6 summarises the pros and cons of these two systems.

Both systems can be used nationwide, because the regional code is unique. However, DPO ID system uses only 2 alphabets for a short name of its own promotion area. When out from the particular area, obviously the short name will no longer be unique. Thus, this system needs to be modified to be used nationwide. The BBLP ID system is using Livestock region and province ID which results in less code needed as it covers a larger area. Both systems use a unique ID, so they are definitely suitable for a computer database system.

These two systems designed to be used mainly for cattle have two weaknesses. Firstly, they would not be suitable for very large number of animals as they are limited to a maximum of 9 999 animals born in the same area, annually. If the population is expanding, more digits need to be added. Secondly, if they would be applied to any other type of livestock, the ID would not be unique, because, there is no code designed for species indication.

In both ID systems animals are permanently tagged and a positive identification can be obtained easily.

In general, both systems are almost identically designed to serve breeding plans for each department and results are equally satisfactory.

Impact of cattle identification system

Since the systems mentioned above are designed mainly for breeding planning and animal disease control, these topics should be discussed in depth.

Table 6. Comparison between BBLP ID and DPO ID System.

Topic	BBLP ID System	DPO ID System
Nationwide Deployment	Yes	Yes, with some modification
Suitable for Computer Database System	Yes	Yes
Species Applicable	Cattle only	Cattle only
Large Population Applicable	Yes, with some modification	Yes, with some modification
Positive Identity	Yes, (Ear Tags)	Yes, (Ear Tags)
User Friendly	Yes, after trained	Yes, after trained
Expandable	Yes	Yes, with some limitation

Genetic improvement

A successful breeding program needs many factors. One of these factors is a unique ID for all animals in a breeding plan. Researchers need these ID to follow activities concerning a particular animal. Artificial insemination data, milk records, nutritional data, etc are all based directly on one single animal. At present, there are more than 507 000 dairy cattle registered in the database system for approximately 30 000 registered dairy farms. After almost half a decade of using AI techniques to improve dairy cattle performance, there have been a significant number of reports indicating a successful improvement of dairy herds and beef cattle.

Sanpote and Buaban (2003) reported a genetic trend of milking performance of 6 357 pedigree cows recorded between 1990 and 2002 in Thailand. They found that genetic improvement of milk production was 23 kg per year or about 0.6% in terms of 305-day milk, fat and protein yields. They also reported an increase of phenotypic milk production of approximately 99.08 kg per year or 2.71%. The phenotypic trend of fat and protein yield, also followed the same trend. Buaban *et al.* (2003) studied the genetic transmitting ability of dairy sires of different origin under Thai conditions. They found that sires from Japan gave the highest average breeding value of 305-day milk yield, followed by sires from United State and Canada ($p<0.01$). the sires originating from Thailand including crossbred and purebred and sires originating from Australia, Italy and UK were not significantly different in terms of 305-day milk yield. These are only some examples of genetic impact resulting from deployment of dairy cattle ID system in this country. There are also some progeny projects running under the Division of Animal Husbandry, DLD and DPO. The DPO is also carrying out progeny tests by using its own bulls. The Animal Husbandry Division is doing a series of researches on development of a Thai-Friesian breed.

Veterinary disease control

Animal disease control is another area that may benefit from using active ID system. The surveillance of veterinary deceases needs the system that can control the movement of animals whether international or domestic. Table 7 shows the statistics of animals dead from epidemic diseases in Thailand in the past 10 year. By knowing the animal origin, we can trace back to the point of origin of the disease. For example, the recent outbreak of Avian Flu which affected significantly the country economic system. One important weakness in Thai disease control system is the lack of ID for poultry, even in commercial flocks.

At present, DLD is working on a very important project which is called 'Origin Traceability of Livestock Products Program'. The project is an effort to combine every ID system in livestock industry to one organisation. The objective is to create an ability to trace back to the origin of any livestock product from farm to consumer. The effect will not only be beneficial on disease control, but also yield healthy food products for consumer.

Table 7. Statistic of the number of animal dead from epidemic diseases in Thailand (Livestock Statistic, www.dld.go.th).

Year	Cattle	Buffalo	Swine
1993	48	12	9
1994	444	38	81
1995	106	72	74
1996	56	166	1 147
1997	87	12	819
1998	33	9	2 557
1999	7	2	4 806
2000	59	99	1 547
2001	375	611	4 630
2002	304	28	884

Conclusion

Although, Thailand has deployed many ID systems for livestock, none of them was considered as a national standard. In the near future, DLD will migrate to the new computer database system. This system has been developed for over 3 years by National Electronic and Computer Technology Center (NECTEC), which includes all features concerning dairy cattle and will be used nationwide. It will not be smooth to switch from one system to another one since the revision of a database system needs a large sum of money and is time consuming. We still need a significant effort to deploy effective ID system for livestock in general.

To organize a national livestock ID system is necessary more effort and direct support from the government. With more than 10 years experience in this field, the author suggests that a national organization responsible for these ID systems is needed. It should have all the powers and resources

to brings all current ID systems to one single system. It might be possible to start with one system that is already used nationwide and could be accepted as 'de-facto standard', such as cattle ID system from both DLD and DPO. This could also make the country stronger on any trade conflict arising from the world free trade marketing system. Some supervision from an international organization like ICAR is needed to design the system to perform as expected in the global context.

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A French consultant's view of the Mexico planning experience of cattle identification and traceability

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A declared intention shared by SAGARPA and CNOG

Early in 2002, the Ministry of Agriculture General Secretariat for Livestock (SAGARPA) and the National Confederation of Livestock Farmers' Organisations (CNOG) of Mexico jointly decided to implement without delay a national system of cattle identification and traceability, the SINIIGA ("National System For the Individual Identification of Bovine Animals").

On the principle of the compulsory identification of keepers of bovine animals and livestock holdings on the one hand, and of the bovine animals on the other, the objective shared by Public Authorities and livestock farmers' representatives is to make it possible to develop information systems, based on individual, unique and generalised identification of the animals, to reinforce in particular:

- the epidemiological monitoring and health inspection of the national herd;
- the control of animal movements;
- the genetic management of populations (registration and management of performances and genealogies),
- the promotion of the products (traceability from farm to slaughter-house, indication of origin)
- the management of financial subsidies per head of cattle.

From the time the decision was taken, this voluntarist approach of the SAGARPA and the CNOG implicitly meant that roles and financing would be shared: SAGARPA, the decision-making authority, would be

The authors wish to express their thanks to the Mexican managers of the SAGARPA and the CNOG for their confidence and for the quality of the relationships now established for more than year. They would also like to thank the various French experts who are working in this project for their technical contributions and their availability.

responsible for the initial investments; the field project management and the operational costs of the SINIIGA returning eventually to the CNOG, the Regional Livestock Farmers' Associations and to all the farmers.

Advisory support by the Institut de l'Elevage and French Professional Organisations for the implementation of the identification system

In the spring of 2002, the SAGARPA and the CNOG officially requested the intervention of the French Herbivores Technical Institute and the Bureau of International Technical Cooperation of French professional livestock organisations (BCTI). The purpose of this intervention is long term advisory support for the conception and implementation of the national cattle identification system and its uses for the genetic improvement and commercialisation of products.
So the request concerned neither a preliminary technical and financial feasibility study, nor the transfer of a «technological package» or of a «model». It concerned guidance and advisory support for the progressive construction of a system appropriate to the realities, needs and resources of Mexican livestock.
So, on the basis of a transfer of experience and know-how, the Institut de l'Elevage and the BCTI have since January 2003 been providing technical assistance to the system decision-making authority and to the master of works body; namely guidance and advisory support for Mexican decisions-makers in making a succession of decisions and in the actual translation of these decisions in technical terms.
For this purpose, an engineer from the Institut de l'Elevage is providing permanent and overall support in engineering the SINIIGA project, as well as providing the interface with the different French experts mobilised from time to time at the request of the SAGARPA and the CNOG.

The conception of a Mexican individual and generalised identification system for bovine animals

The definition and implementation of an individual and generalised identification system for bovine animals, as well as its various uses, involve a large number of players (directly or indirectly), at different geographical levels (national, regional, local) and with different time limits. The success of such a project requires that this complexity is taken fully into account.
The management by the SAGARPA and the CNOG of this long term project and with different stages has been structured, since work was launched in January 2003, around 3 main directions of work:

1. *the overall engineering of the project*: setting up a National Steering Committee and a National Technical Committee, definition and running of the project plan, programming the work, system of follow-up and inspection, training the different players and communication.
2. *the organisation of the system architecture and its information system*: events and types of data registered; procedures and flows of materials / information; functions and responsibilities of the different players concerned; relations with other existing information systems; regulatory and financial framework.

3. *the technological resources of the system*: identification media (ear tags, microchips...); physical media and conditions for transmitting information, management of information (software and data bases).

Overall project engineering

Decision-making authorities

The composition of national strategic and technical decision-making authorities reflects the desire of the SAGARPA and the CNOG to share the construction and steering of the national identification system, to ensure that it is suitably adapted to the needs and resources of Mexican livestock. Constituted when work first started, the Steering Committee and the National Technical Committee are in fact composed of a combination of deciders and technical experts both from the SAGARPA and from the CNOG.
As the project progresses, these Committees are gradually expanding to include representatives of regional (Regional Livestock Farmers' Associations, regional delegations of the SAGARPA) and national (National Council for Genetic Resources -CONARGEN-,...) authorities. Similarly, the constitution of thematic working sub-groups (system technology, training/communication, relations with other information systems...) is already envisaged.

Reference framework document for the definition of the system architecture

To provide a methodological framework for consideration of the project and managing it, a reference document has been drawn up by our Cooperation Bureau on the basis of more than 30 years of experience, acquired by the Institut de l'Elevage and professional livestock organisations, in the implementation of the French identification and traceability system.
In addition to matters related with programming objectives, phases of work and time limits, the purpose of this draft project is to list and rank the various elements to be defined for organising the system and its information system: events (birth, movements, slaughter,...), type of data to be registered and flows of information for each event; national, regional and local functions to be taken on...
Periodically updated by the Mexican authorities, additions are gradually made as a result of meetings of the Committees, on-the-spot missions by French experts and missions by Mexican experts in France. It is in fact the framework for the construction of the system architecture and for the operation of the whole information system.

Objectives, programming and time limits

The launch of this individual and generalised cattle identification project benefits from a programme of financial assistance to livestock farmers set up by the Mexican Ministry of Agriculture (the PROGAN), one of the lines of action of the «Official Sectional Programme for Agriculture and Livestock 2001-2006». With the objective of improving forage production and reducing the erosion of grazing land, the PROGAN plans to provide financial assistance to livestock farmers, based on a diagnosis of the

holding and in return for commitments, in particular on the identification of their animals, and on participation in national health campaigns and improvement in grazing land management.

- The first phase of the SINIIGA was launched in the second quarter of 2004. It concerns the identification of cows and heifers of farmers who are members of PROGAN, animals serving in the calculation of the amount of premiums received by a farmer in the framework of this programme, and of all the animals belonging to members of Herd-Books. The farmers concerned will obtain these identification tags free of charge. For 2004, according to available data, this phase concerns 100 000 farmers and about 4 million animals.
- The second phase of the SINIIGA concerns the compulsory identification of all other bovine animals belonging to farmers benefiting from the PROGAN. It should be launched in the last quarter of 2004. The corresponding identification tags will be paid for by the farmer. Identification should then concern 10 million animals for the 100 000 member farmers in the PROGAN in 2004.
- The third phase of the SINIIGA concerns the identification with SINIIGA type tags of all animals in the health inspection. The plastic "SINIIGA" tags with the national number then also become the official tags for the health system, replacing the old metal tags with a number specific to each State. This 3rd phase should be initiated in 2005 with the promulgation of an official federal decree.

Public awareness and training

In addition to constituting national decision-making authorities and gradually completing this framework document, an important part of the activities has been devoted to raising the awareness of the different players involved in the project and in initiating the training of technical managers for the system.

- Study trips and visits by delegations have been organised in France for mixed groups composed of Mexican players and decision-takers (national and regional livestock farmers' representatives, Herd Books, commercial operators, fatteners and slaughterers, support services for production and SAGARPA veterinary services,…), to present to them the challenges of an individual generalised identification system and traceability, its organisation and its various developments.
- Six members of the Technical Committee attended a specific 3-week training course in France (in Paris then in various French regions) in October 2003, with the participation of experts from the Institut de l'Elevage, different services of the French Ministry of Agriculture and various French livestock professional organisations directly involved in implementing the French system and its developments (EDE, ARSOE, cooperatives, commercial operators, slaughterers, etc…).
- Similarly, several expertise and technical support missions carried out in Mexico have been the opportunity to present, jointly with the Mexican Technical Committee, the principles and possible uses of an identification and traceability system, lessons learned from French

experience, the methods envisaged for implementation in Mexico, etc… at General Meetings of the CNOG, and the CONARGEN, meetings of Herd-Books, meetings of Regional Directors of the SAGARPA, meetings of livestock farmers' managers of Regional Associations,…

Technological resources used

Animal identification media

In addition to branding, bovine animal identification in the framework of the health inspection of animal movements was already generalised in Mexico with the use of metal tags. Nevertheless, some farmers are already using plastic marker tags, whether in the context of Herd Books or for the internal management of their herd.

To implement the national identification system, the choice of the type of animal identification media by the SAGARPA and the CNOG has been made on 2 principal criteria:

1. its accessibility (cost, application, use and legibility…) to the greatest number of farmers and notably to the smallest holders.
2. the experience acquired (rate of loss…) and the reliability of the logistics (order, delivery, retagging…) of the manufacturer able to supply them.

On this basis, the choice fell on yellow visual plastic tags, for a dual identification of the animal: on one ear a pair of large tags, on the other a pair of button tags. Every farmer who so wishes can replace one of the visual button tags by an electronic button tag, by paying the extra charge. The Allflex company was selected in December 2003 as the supplier after an international invitation to tender, and the delivery of 4.3 million pairs of ear tags and 30 000 applicators is planned for 2004.

The type of official numbering is MX + 2 State figures + 8 consecutive figures (+ barcode).

To assess the quality of the type of tags chosen, a national testing and inspection system is being organised by the CNOG: tag application and the operation of applicators have been tested in two abattoirs; loss rate and tag legibility will be specifically monitored on 4 500 animals spread over 30 holdings and 3 regions, chosen for their diversity in terms of herd management, breeds and climate and pasture conditions.

Information system and data base(s)

The SINIIGA information system has to carry out the registration, transmission, utilisation, inspection and management of the data associated with the identified animals. To determine its architecture and operation, Specifications of Field Operations (SFO) are being defined by the SINIIGA Technical Committee. This technical document will define and describe the responsibilities, tasks and procedures to be respected by the different players of the SINIIGA, as well as the format and content of the flows of information associated with its implementation (see following section).

Until this document is available and the corresponding information system established, only data concerning the material accounts of the tags (numbers manufactured and location of corresponding tags: in stock,

within the farm, placed on the animal,…) are presently being managed. The data associated with animal identification are stored and archived in paper form until they can be registered in the future information system. On the other hand, the SAGARPA and the CNOG may choose to divide up the data bases (each State with a database, hosted within each Regional Livestock Farmers' Association) with periodic centralisation of information in a national data base. Even if this configuration involves investment and maintenance costs that are higher than a single centralised data base, it is less sensitive to malfunctions, specific uses are easier to develop at individual State level, and it adapts better to steering shared between livestock farmers' organisations and the public authorities.

The organisation of the SINIIGA and its information system

Although aspects associated with the technology used by the identification system usually attract all the attention, the first key factor for success seems to lie in the overall operational organisation of the system: what types of information for what types of events? Who does what and how? What is the regulatory framework (whether promulgated by a country in the case of a generalised identification as in Mexico or defined by a private player, for example in the case of identification of animals for a specific marketing sector)? What relations with other existing information systems (genetics, health…) ?

What types of information for what events? Who does what and how?

The organisation of the SINIIGA depends first of all on the definition of:

- the different events taken into account, and for each of them, the various information registered and managed in the information system;
- the format and content (type of codification…) of the different official material media used (identification tags, documents notifying events, documents for ordering tags, farm register,…)
- the responsibilities and tasks of the official players in the system at grass roots level, regional project manager and keepers of bovine animals (allocation of identification numbers; ordering, distribution and material accounting of tags animal tagging and retagging, collection, registering and transmission of information, publication and dispatch of official documents, etc…)
- the procedures for time limits to be respected for each task to be carried out, the content and format of the flows of information and materials at each stage of identification, and of corrective measures in the event of non compliance.

These different elements, which are being defined by the Technical Committee, will be combined in Specifications of Field Operations (SFO), which will be the reference document for applying the regulatory framework promulgated by the Federal Ministry of Agriculture. Although the Federal Ministry specifies the essential of each player's responsibilities, the SGO specifies much more "how" the player must carry them out.

As an example, the different events taken into account in the SINIIGA and the information registered for one of them are shown in the following tables:

Events taken into account in the first phase of the SINIIGA

- Request by a physical or moral person for registration as keeper of bovine animals
- Request by a physical or moral person for registration of a livestock holding
- Notification of birth or import of a bovine animal
- Entry of a bovine animal into the holding
- Departure of a bovine animal from the holding
- Request for tags for identification
- Request for tags for retagging
- Notification of slaughter
- Request for registration as identifying agent

Information notified for the event "entry of a bovine animal into the holding"

- SINIIGA identification number of the bovine animal
- SINIIGA identification number of the holding
- SINIIGA identification number of the holding of origin
- Date of entry
- Cause of entry

In the transition phase, if the entering bovine animal is not identified with a SINIIGA number, tags must be placed on it and the following information (as for an event "notification of birth or import") are notified:

- Country of origin
- Official identification number in country of origin (if imported bovine animal)
- SINIIGA identification number allocated
- Previous identification number(s) (health, Herd Book...)
- Breed type
- Date of identification
- Code of the identifier

It should be noted that other information (SINIIGA number of the sire and dam, breed type of the sire and dam, birth weight, result of tuberculin test, etc...) associated with the different uses of the SINIIGA (strengthening the genetic management of populations, health inspection...), will only be taken into account in a second phase of the project.

Which regulatory framework?

In the case of the SINIIGA, with an eventual objective of obligatory individual and generalised identification of cattle, the Mexican Ministry of Agriculture plays a determining role, even if the implementation is delegated to the private professional sector. After taking the decision jointly with the CNOG, it gave the impetus and support for the definition and launch of the system. Regulation and guidance in the development

of the system according to needs, as well as the maintenance of national consistency in its application, will also be under its control in the years to come.
A preliminary regulatory framework, which will be promulgated by decree in consultation with the CNOG, is in the process of being defined. It will approve the various specifications of the system (field procedures, responsibilities and obligations of the different players, identification media to be used…) and will define the conditions of management and access to data, inspections and sanctions… after that, it will be modified and complemented according to the experience acquired and the way the system develops.

What relations with other existing information systems?

For some time now, public and private players in Mexico have already been developing identification and information systems, using media (plastic or metal tags, tattoos)and types of numbering that may differ considerably one from the other. The health services and the Herd Books are the main examples of these.
As in every individual and generalised identification project, the programmed and gradual movement of these different systems to one single type of identifier and to homogeneous operational methods, is a delicate phase, both to have them accepted and to ensure their smooth transition without undue disruption.
In 2003, listing the operational methods of these systems and the practical experience of the players concerned was a task in itself for the SINIIGA Technical Committee. With this in mind, one of its members, belonging to the Mexican National Council for Genetic Resources (CONARGEN), was more particularly in charge of relations with Herd Books, which were to join the SINIIGA in 2004. In the same way, a member of the Technical Committee will in future be more particularly in charge of relations with the public veterinary services, to organise the transition in 2005/2006 of the present identification and health inspection system.

Conclusions

As in the Mexican experience, the definition and implementation of an individual identification system and traceability is a complex project, involving a large number of players (private and public), concerning different geographical levels (national, regional, local) and offering various possibilities of use.
Its success depends of course on technological aspects (type of identification medium, software and data bases, method of transmitting information…)… but above all on rigorous attention to the overall engineering of the project, to the organisation of the system itself and of its information system.
This organisation of the system and its information system is specific to each country, depending on the objectives sought, the time limits fixed, the resources available, the existing organisations, etc.

So the purpose of present advisory support for such projects by the French Herbivores Technical Institute (*Institut de l'Elevage*) and the Bureau of International Technical Cooperation of French professional livestock organisations (BCTI), is not to transfer a "technological package" but to transfer experience, know-how and expertise on overall project engineering as well as technological and organisational aspects.
Whether the principals are Public Authorities (in the case of an obligatory and generalised system) or private players (in the case, for example, of a system limited to a sector), we advise the Steering Committee and Technical Committee in their decision taking, then in their actual translation in technical and practical terms. To make this possible, we can rely on 30 years' experience acquired in the implementation and evolution of the French system and in cooperation on this theme with other countries.
The situation in each country is different: no one model !

Systems of cattle identification and recording: the Chilean experience

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General background

Brief geographical description

Continental Chile, located along the extreme south-west of America, displays some extraordinary geographic features: it is a narrow strip of land, more than 4 200 kilometres long with a maximum width of 375 kilometres and minimum of 90 kilometres, flanked on both sides by two large mountain ranges; the Andes Mountains and the Coastal Range. In between these two mountain ranges lies the Intermediate Depression. Despite the fact that there are some regional differences, these physical features are present until they gradually vanish in the southern sea.
To the east, the high Andean peaks (reaching 7 000 m above sea level) form a natural border with Argentina and Bolivia. To the west lies the Coastal Range with northern heights of a maximum of only 3 000 m above sea level, which gradually decreases towards the south. In the regions known as Norte Chico (Little North), and Central (Central Zone), there are the transverse valleys. These valleys sweep down from the eastern Andes to the western Coastal Range. These peculiarities make flat land scarce in relation to the total land surface area: some 20% of a total of 756 000 km^2.

Arable land

Out of approximately 75.6 million hectares of continental Chile only one third has some agriculture and forestry potential. This area is divided in the following way:

- 8.5 million hectares : livestock breeding potential
- 11.6 million hectares : forestry potential
- 5.1 million hectares : arable land
- (1.8 irrigated and 1.3 potentially irrigable; 2.0 of dryland).

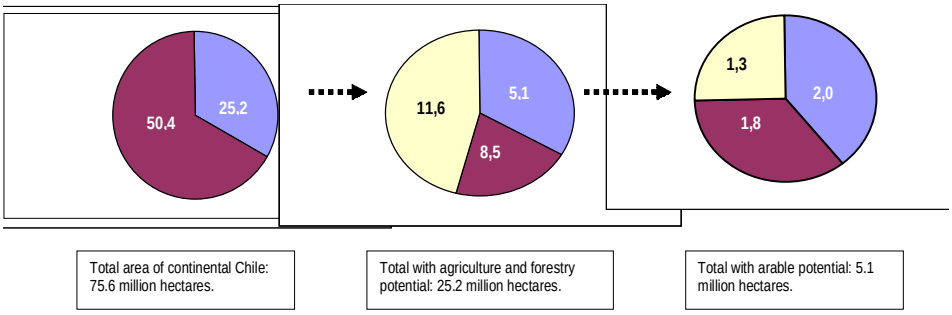


Figure 1. Arable land distribution in Chile.

The Chilean bovine population

There are four million heads of cattle in Chile, most of which are in the southern regions, specifically the eighth ninth and tenth regions, as you can see in Table 1.
In effect, as the table demonstrates, 71% of the entire cow population is amassed in three regions, in which the tenth alone holds 40%.
The predominant productive system is extensive dual-purpose, in other words, farms that produce both beef and milk, which are intimately related to the eco-system that sustains them.
Last but no least, it is important to mention that a large proportion of Chile's cattle are in the hands of small-scale agriculturists (over 40%), as reported in Table 2.

Table 1. Heads of cattle per region, according to the 1997 Livestock Census.

Region	Nº Heads	% per Region
I	4 618	0.1%
II	524	0.0%
III	6 606	0.2%
IV	38 792	0.9%
V	131 671	3.2%
RM	164 014	4.0%
VI	155 997	3.8%
VII	367 447	9.0%
VIII	550 432	13.4%
IX	784 336	19.1%
X	1 587 557	38.7%
XI	168 770	4.1%
XII	137 674	3.4%
Total cow population	4 098 438	100%

Table 2. Cattle distribution among producer types.

Producer Type	All Cows	Dairy Cows
Large scale	38.01%	37.63%
Medium scale	18.81%	19.58%
Small scale	37.50%	39.61%
Familial subsistence	4.88%	2.78%
No Purpose	0.01%	0.00%
Unclassified	0.79%	0.39%

Chile's present situation in identification and registry

At the present moment, Chile is without a nationalized system of identification. There exist only two ventures in this area, the first by existing programs of dairy control (there are three active programs in Chile). These are in the hands of private companies that lend a service to dairy farms, who, as a condition, must have their herds correctly identified. This information is only available to those companies providing the service, and this covers 250 000 of 700 000 milk cows.

The second venture corresponds to the efforts in identification and registration that each individual farm makes, and are only used within that farm. This method is widely used in commercial agriculture, but the data is of inferior quality, with high levels of loss of information, with little possibility of depicting the situation correctly. The number of animals identified in this manner is estimated at approximately 1.2 million.

System of cattle identification and recording in Chile

Attributes of the system

The system proposed, intends to be of voluntary adscription. However, due to the establishment of incentives for the owners who join the system, wide spread national cover is expected.

The proposed system is simple, consisting of an unique national identification correlative number.

Identification of cattle will be done with duplicated devices, as follows:

- A visual identification tag with bar code allowing an automatic reading, will be put in one ear.
- A duplicated identification device, consisting of a visual tag, or an electronic visual tag, or an intraruminal identification capsule, will be simultaneously used.

Finally in reference to the documents controlling cattle movement, it was decided that the present transit guide (document used in actuality for the transport of cattle) will be used, improved in the aspects of individual identification and access to said information.

System structure and unit functions

The structure of the proposed system is exemplified in Figure 1. As the figure shows, there are three[1] participants in this system, the *central administrative* unit, the *operative* unit and the agriculturists (milk / beef farmers). The duties corresponding to each unit are the ones reported in Figure 1.

Central administrative unit

Some of the functions assigned to this unit are:

- Watch over the efficiency and good use of the system.
- Assign and control the unique identity numbers.
- Develop, modernize and come to a consensus with the technical specifications of the system.
- To hire the necessary information services.
- To be the executive and technical counterpart of any hired service.
- To define levels of access to information.
- Maintain and guarantee access for health services to available information.

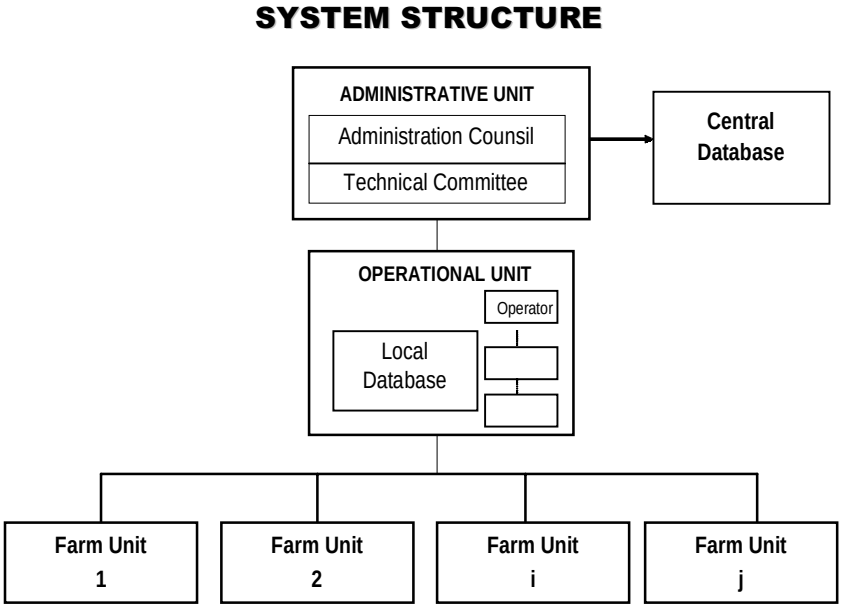


Figura 1. Duties corresponding to each unit.

[1]In this system a fourth unit may be recognized in the *device suppliers*. These suppliers are private companies that will find this an attractive business opportunity, offering different kinds of devices that comply with specifications made by the *central administrative* unit. They will be previously certified to supply their product to those who need them.
Each accredited supplier will be given a numbered rank, defined the administrative unit. This will allow them to mass produce and keep stock of devices (rings), thus making their sales logistics more efficient.
The *device suppliers* will deal with two kinds of clientele:

- The milk / beef farmers who will acquire these devices directly.
- The *operative* units, having once provided service, will themselves offer to supply the farmer's demand for said devices, guaranteeing convenient prices and reliable products.

- Coordinate interaction with private and public entities.
- To certify operative units, suppliers etc.

Operative unit

The concept of *operative* unit was born as an organization that "*facilitates the identification process and guarantees the quality of information obtained from each farm*".
It is a private entity that through its informational service centralizes the information in a clear and suitable manner.

Farm unit

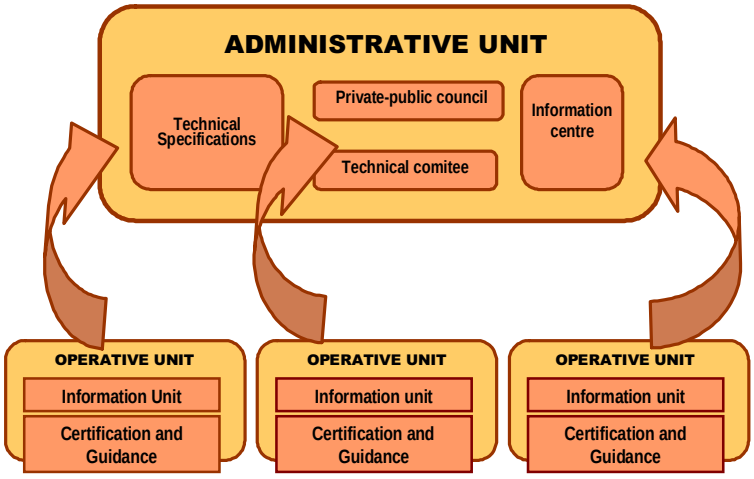
This is a private unit where the information is generated. Said information is gathered by the operative unit to form a centralized data base.
The producer (or farm unit) may choose the operative unit with which to work. A minimum of one operative unit per region will be guaranteed, assuring access to the system for all the producers or farm units.
The farms will de supervised by two separate entities:

- The *operative* unit that will have permanent supervision due to the registry of information that it handles.
- The SAG (Agricultural and Livestock Service), by means of certified veterinarians who will supervise the health and identification of the farm's livestock.

How system components relate

Central Data-base vs. Operative Units

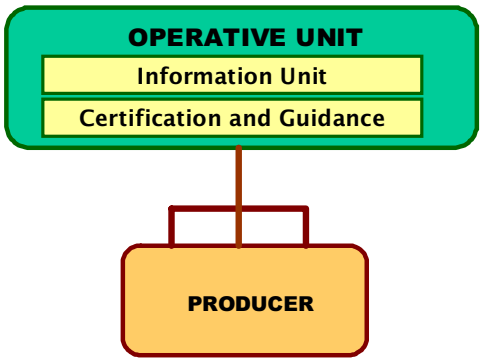
The creation of independent operative units (with their own data-bases) that reliably deliver essential information, previously defined, pertaining to an individual animal to the *central data-base*. The passing of information from operative units to the central data-base is a crucial process in this system.
The aforementioned does **not** limit the amount of information handled, or the services offered by the operative unit. Both are variables that give added value, at the time that the producer decides with which operative unit to work with.



The kind of alliance achieved between the operative unit, farm unit and central data-base (if it outsources this service), will make this decision more or less attractive.
It must be mentioned that a data-base may lend service to more than one operative unit.

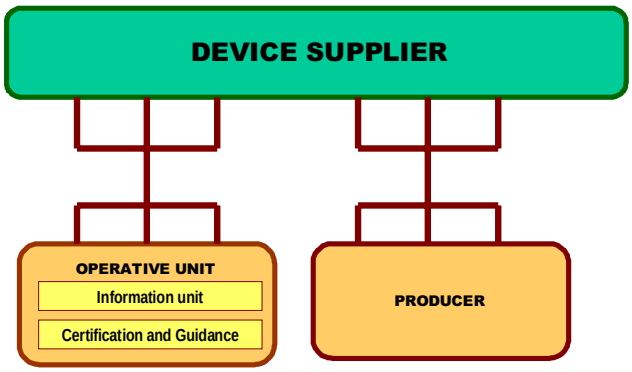
Farm unit vs. Operative Unit

Every producer will be able to turn to an accredited operative unit that controls and acts as officiate of the identification process, being the nexus between producer and the central administration unit.
It is emphasized that the presence of operative units in every region in the country will facilitate the producer's access to the system. If for some reason a region is without an operative unit, the nearest one will be requested to extend its services, guaranteeing in this manner total national coverage.



Operative Unit – Producer vs. Device Suppliers

The *device suppliers* are private entities that will find this system an attractive business opportunity. The operative unit and farm unit will buy identification devices from only certified (certified by the central administration unit) suppliers, opting for the most convenient offer.



Though the operative units and farmers may choose indistinctly any of the accredited device suppliers, it is probable that alliances will form between them, motivated by the suppliers efforts to maintain an optimal level of demand, in order to stay in business.
The necessary communication between these three entities will be of great importance in order to conserve control over the devices they sell, and in doing so, achieve unity. That is how it will be assured that device suppliers and producers alike will inform the operative unit (during periods yet to be defined) of the sale and use of devices (accordingly). This is the only instance where information is doubly checked, validating the consistency of the data.

Financing

The fundamental premise considered in the identification system proposed, is that the consumers (directly or indirectly) be willing to give additional benefits to producers, in return for the correct identification of the farm's animals. This, in addition to the subject of voluntary cooperation, and the fact that it promotes technological advance at farm levels, that it will result in the enhancement of farm productivity, impels a mixed funding.
The design and function of the administrative unit, including the central data-base will be the responsibility of the state. Private entities will be responsible for contributing with those costs related to the identification process itself (identity rings and their placement), as well as the costs involved in maintaining data in the operative unit.
Faced with particular situations, the state can count on support, for example, the incorporation of small-scale agriculture in the system.

Brazilian and Mercosur experiences in development and implementation of animal identification and recording systems

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Summary

Customer demands for food safety and origin certification are causing major challenges to the livestock industry. Mercosur countries are quickly developing and adopting animal identification and recording systems to comply with the required product traceability. In this matter, Brazil has been pioneer in implementing the Brazilian Bovine and Bubaline Identification and Certification System (SISBOV) in 2002. This system aims individual certification of origin, identification, registration and monitoring. Each animal has a unique individual identification system and receives an animal identification document (DIA), which is equivalent to a passport, and must accompany the animal in every movement. Currently, to be considered traced and exported, animals have to stay in the system for 40 days before the DIA may be issued. As of April 2004, there were about 15 million animals registered in SISBOV. Similar systems are being adopted in Argentina and Uruguay, whereas sanitary problems regarding the Food and Mouth disease have hindered the implementation of traceability programs in Paraguay. Mercosur countries, particularly Argentina, Brazil and Uruguay, are in a key position to supply beef products complying with the most exigent consumer's requirements and, in this regard, are adopting highly reliable and auditable traceability systems of their cattle populations.

Keywords: beef cattle, identification, mercosur, origin certification, recording, traceability.

Introduction

Since the beginning of the last century, animal identification and recording (I&R) systems have been implemented in Argentina, Brazil, Paraguay and Uruguay, which are the countries composing the Mercosur common trade market. These I&R systems were focused on pedigree information from purebred animals and maintained by breed associations (herd books). During the 1970's performance recording geared towards the establishment of data based genetic improvement programs was implemented.

Recently, a whole new paradigm has surged in animal I&R systems. New customer demands for food safety and origin certification are causing major challenges to the livestock industry. This has being particularly relevant for beef commodities, since several factors triggered by the Bovine Spongiform Encephalopathy (BSE) outbreaks in Europe, Canada, United States and Japan have severely damaged consumer trust in cattle products. Beef commodities consist in one of the most important exports for Mercosur countries, particularly Argentina, Brazil and Uruguay, which compose a long-established beef production region (see Table 1**)**. In 2001, the Mercosur countries accounted for 16% of the world beef production and 17% of the beef exports (FAOSTAT data, 2004). Therefore, this paper focuses I&R systems for cattle, even so, most concepts also apply to other livestock species, e.g. sheep and goats.

The European Union (EU) is a key market for Mercosur beef. Thereby, the associated countries are quickly developing and adopting animal I&R systems to comply with product traceability (defined as the ability to follow all information concerning the animal health, sanitary, management and alimentary conditions, as well as location, movements and processes occurred from birth to consumer table), which is demanded by EU customers.

The objective of this paper is to describe the main actions taking place in Mercosur countries to assure traceability of beef products. Brazil has been pioneer among Mercosur members in developing traceability systems and a more comprehensive description of the Brazilian system is given below, followed by some key action been taken in the other countries composing the Mercosur free trade market.

Mercosur strategies and animal I&R systems towards product traceability

The external market is the chief price maker for beef products in Mercosur countries, i.e., in times when exports were low prices were also low and vice-versa. In order to maintain the current markets and to attain new markets in the future, it is imperative to offer safe and origin certified products. In the EU, Regulation (EC) No 1760/2000 of the European Parliament and Council established a system for the identification and registration of bovine animals and regarding the labelling of beef and beef products. According to these regulations, animals should be individually identified by an ear tag applied in each ear and accompanied by a passport throughout all movements, in order to permit bovine animals to be traced. Moreover, all EU members must have a National database

Table 1. Population, bovine herd stock, production, exports and consumption of beef products for Mercosur countries in 2001.

Country	Population (1 000)	Cattle stock (1 000)	Beef production (1 000 MT[1])	Beef exports, (1,000 MT[1]) (% production)	Beef consumption, (kg / yr / person)
Argentina	37 529	48 851	2 452	191 (8%)	56.5
Brazil	174 029	176 389	6 671	798 (12%)	34.3
Paraguay	5 604	9 889	250	59 (24%)	33.9
Uruguay	3 366	10 595	317	186 (59%)	54.5

Source: FAOSTAT data, 2004
1 MT= Metric Tons

to register individually each animal ID and main characteristics (e.g., birth date, gender, breed, and country of origin). All producers and farms must also be registered in this database.
These requirements also apply to EU beef suppliers, including the Mercosur countries, which are in the process of developing their national systems, with distinct levels of accomplishment, as described below.

The Brazilian Bovine and Bubaline Identification and Certification System - SISBOV

In February 2002, the SISBOV (Sistema Brasileiro de Identificação e Certificação de Origem Bovina e Bubalina; Ries & Antunes, 2003) was created by Ministry of Agriculture, Livestock and Food Supply – MAPA's Agricultural Defense Secretariat. SISBOV's objective is to accomplish the individual certification of origin, identification, registration and monitoring of all bovine and bubaline animals, both national and imported. Since July 2002, all slaughtered animals to be exported to the EU must be registered in SISBOV.
This system functions in partnership with the private sector. MAPA accredits public and private national organizations, which actually do the certification process alongside the beef producers. New rules have been recently established, through normative resolution Nº21 of April 2, 2004 (Ministério da Agricultura, Pecuária e Abastecimento, 2004), to facilitate the functionality of the system, to standardize the identification stamps, and to improve disease control. The process to register a producer, farm and animals in SISBOV is as follows:

1) Registration of the producer and its farm(s) in the SISBOV though a certifying organization;
2) Producer indicates how many animals will be registered in the program and the dual identification method to be used (see Table 2 for options);
3) Producer identifies the animals using the identification devices provide by SISBOV though a certifying organization;

4) An auditor accredit by the certifying organization must visit the farm, audit the animals and fill a report to be forwarded to certifying organization;
5) Animals are registered in the SISBOV National database by certifying organization;
6) Any movements, sanitary and nutritional management must be registered in the system by the producer, using an interface software developed and supplied by the certifying organizations conforming with MAPA's regulations;
7) The traceability cycle for an animal closes with its slaughtering in a certified plant or by its death.

The SISBOV identification system

Each animal has an individual identification, unique in the whole Country, issued and controlled by the SISBOV's coordination and composed of 15 digits: the first three digits characterize the Country of birth; the two subsequent digits represent the State of origin; the nine subsequent digits identify the bovine or bubaline (of these nine digits, the last six are considered the management or working number of the animal), and the last number is a verification digit. Each animal must have dual identification, following one of the options described in Table 2.
Colour coding is also used in this system: the standard colour for ear tags is yellow; whereas white indicates an imported animal and orange is used in case a lost original ear tag has to be replaced.

Table 2. Dual identification options permitted by the Brazilian Bovine and Bubaline Identification and Certification System – SISBOV[a].

Option	Primary ID	Secondary ID
I	SISBOV ear tag[1] in the right ear	Button ear tag[1] in the left ear with the management number[2]
II	SISBOV ear tag in the right ear	Electronic device
III	SISBOV ear tag in the right ear	Tattoo in the left ear of the management number
IV	SISBOV ear tag in the right ear	Iron brand in the right hind limb lower portion (in two rows of three numbers) of the management number

[a]Animals registered in breed associations may additionally have their registration number in a tattoo or ear tag, as long as their SISBOV complete and management numbers are printed in the registration document.
[1]See Figure 1.
[2]SISBOV's 9th to 14th digits.

Figure 1. Regular and button ear tags used by the Brazilian – SISBOV.

The Animal Identification Document

Each individual registered in SISBOV has an animal identification document (DIA). This document is the official SISBOV identification, being equivalent to a passport, and must accompany the animal in every movement. Information contained in the DIA includes: the number of the animal in the SISBOV and in the certifying organization; country of origin; breed; gender; farm of birth; city and state of birth, city and state of identification, identification date, birth date, identification of the certifying organization and MAPA's logo. The DIA is issued by the certifying organizations based on information contained in the National database. After animals death (natural or slaughter) the document is confiscated and the animal removed from the database.

To be considered traced and allowed to be exported to EU, the minimal time that an animal has to stay in the system before the DIA may be issued was established by MAPA in Normative Resolution 88/2003, according with the calendar presented below.

SISBOV's Calendar

Animals to be exported to the EU and other markets, will be released to be slaughtered after accomplished the following requirements:

a) From May 31, 2004, remaining a minimal of 90 days in the SISBOV's National database.
b) From November 30, 2004, remaining a minimal of 180 days in the SISBOV's National database.
c) From May 31, 2005, remaining a minimal of 365 days in the SISBOV's National database.

All animals originated from farms located in Food and Mouth disease free States (Bahía, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Río de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo, Sergipe, Tocantins, federal district, and Rondônia) must be included in the SISBOV National data base by 31 December 2005, within 90 days after birth. All animals from all States must be included in the system by 31 December 2007.

As of April 2004, there were 27 accredit certifying organizations and about 15 million animals registered in SISBOV.

Other Mercosur countries

Individual identification and certification systems, similar to SISBOV, are being implemented in the other Mercosur countries with some peculiarities, as described in what follows.

Argentina

In Argentina, Resolution 15/2003 of the Argentinian National Health and Agroalimentary Quality Service - SENASA (Servicio Nacional de Sanidad y Calidad Agroalimentaria, 2004) has established the Identification System of Cattle for Exportation (Sistema de Identificación de Ganado Bovino para Exportación; Ministerio de la Produccion, 2003), with which all farms registered in the Rural Establishments Suppliers of Cattle Slaughtered for Exportation Database must comply, satisfying requirements of external markets, especially the EU.
The identification system is based on ear tags placed in the left ear, following a sequential and unique number, which are provided to the producers by private companies previously registered and accredit by SENASA. Producer registration number is also printed on the back side of the ear tag.
Since 15 August 2003 all animals destined to external markets must be identified and remain in the system for at least 40 days prior to slaughter and all farms supplying animals for exportation must grow animals derived from their own herds or from herds registered in Establishment of Origin database. For each animal an individual identification card is issued and accompanies the animal in all movements, particularly when in transit to the slaughter plants. Moreover, all animals born in these registered farms since Resolution 15/2003 has been published must be identified before weaning and all herd stock must be identified and registered in the system by 30 June 2004. Furthermore, each farm must keep a movements and stock registration book, in which birth, death, purchases and sales of animals, as well as the usage of ear tags, are recorded. Veterinarians accredit by SENASA are responsible to audit the farms, animals and books.

Uruguay

At present, Uruguay is in the transition process from the current group traceability systems to an individual identification and traceability system. The newly created National Cattle Information System - SNIG (Sistema Nacional de Información Gandadera, 2004a,b) has the objective of assure cattle traceability from farm of origin to packing plant, both individually and in groups. This is based in two parallel strategies: the consolidation and optimisation of the current group traceability system and the gradual introduction of an individual traceability system. The system integrates information on animals stock, movements and changes of ownership, as well as productive and sanitary processes.

Producers are currently being invited to voluntarily join a pilot plan, which is the first implementation step of the National individual traceability program (Ministerio de Ganadería, Agricultura y Pesca, 2004). This pilot plan intent to individually identify one million head of young cattle (male less than one year old and females less than two years old), preferably from those producers engaged in branded beef programs, for example Uruguayan natural beef, Organic beef, Hereford beef, etc.
A dual identification systems consisting of a ear tag and an electronic device (either a button shaped ear tag or a ruminal bolus transponder) is being adopted. The number consists of 12 digits, the first three identifying the country and the nine remainder being the animal identification, from which the last four digits correspond to the animal's working number. This identification will be unique and permanent, being unchangeable and not recyclable. The information record in the moment an individual is registered in the system includes: the identification number, the producer code, season and year of birth, animal category, gender and breed. In order to precisely record animal movements, transporters will be equipped with electronic device readers attached to notebooks wireless connected to SNIG.
The SNIG will also be integrated with the Uruguayan Geographic Information System to facilitated the prompt location of animals and farms in the case of disease outbreaks, especially Food and Mouth disease (Sistema Nacional de Información Gandadera, 2004a).

Paraguay

Sanitary problems regarding the Food and Mouth disease status, have closed the most important international markets, including the EU, for Paraguayan beef. This has hindered the implementation of traceability programs in Paraguay and, even though, there is crescent awareness of the Paraguay beef industry for the need of having product traceability, if the important markets are to be recouped (Revista El Productor, 2003). Paraguay is least achieved Mercosur country in this matter.

Conclusions and perspectives

Consumer demand for product safety has cause fundamental changes in beef cattle industry worldwide. This, in addition to raising consumer concerns with animal welfare and environmental conservation has boosted the requirement of origin certification and traceability of beef products and processes from the birth of the animal to the consumer table. This implies the development and implementation of unique, permanent, reliable and audible cattle identification systems.
Mercosur countries, particularly Argentina, Brazil and Uruguay, are in a key position to supply beef products complying with the most exigent consumer's requirements. These countries production systems are, in general, extensive, pasture based and environmentally sound, and they also have good sanitary conditions, particularly regarding BSE and Foot and Mouth disease. Moreover, Brazilian and Uruguayan cattle is completely hormone free, whereas Argentina's herds that sell cattle to

external markets are registered by SENASA and must also be hormone free. In order to recoup lost consumers, maintain the current and attain new markets, these countries have adopted or are in the process of implementing highly reliable and auditable traceability systems of their cattle populations.

Finally, it is important to note that before benefits from these systems can be harvested, there are costs to bare. The development and maintenance of the national databases are being covered by the government, however the cost of animal identification and audition of the systems are being shared with the producers. In Brazil and Argentina the identification cost (of about one Euro per animal if an electronic identification device is not used) are being entirely paid by the producers. Nonetheless, there are cases where the slaughter houses loan the money or even pay such costs, if the producer commit to sell them the traced cattle. On the other hand, Uruguayan government is paying between 50 and 65% of the identification costs of about two Euros including the ear tag and the electronic device.

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Main conclusions of the seminar

General remark

Choice of the most suitable identification system is dependent on local objectives and needs. To get access to high developed markets, identification and registration systems have to meet the required levels (e.g. in the EU-market). It is recognized, that under certain circumstances, e.g. for theft prevention, less sophisticated identification systems are suitable and sufficient. The following recommendations are more focused on situations, where an elevated level of identification and registration is required.

Recommendations

- Introduction of identification systems ensuring uniqueness of identification codes.
- Identification codes should be used that follow "ISO 11784"-rules: 3 digits for country / manufacturer code, 12 digits for individual animal identification code.
- Only one identification code for all purposes (e.g. Disease surveillance programs, performance recording, herdbook, etc.).
- Where suitable (regarding use and cost), electronic identification (RFID) should be considered.
- If electronic and visual identification are used in parallel, electronic ID-devices should be placed on the left side of the animal.
- Preferred type of electronic identification device (inject, eartag, bolus) should be left to the choice of the clients.

General follow-up for ICAR and FAO

- ICAR should clarify with the EU, in exact and specific terms, what their import and traceability requirements are for meat importation from developing countries.
- ICAR to set standards and a testing program for conventional plastic eartags as well as for RFID devices used in official identification systems.
- ICAR and FAO should review in two to three years the current identification and recording schemes being initiated in developing countries and disseminate successes and any lessons learnt.
- ICAR and FAO should prepare guidelines for developing countries wishing to establish an identification and registration systems that would be recognizable by ICAR. Such guidelines should provide a road map (check list) that assists in determining objectives, establishing minimum requirements, technical and implementation options and their implications and sustainability.

- ICAR and FAO should assist in creating greater awareness in developing countries of the benefits of establishing appropriate identification and recording systems.
- As OIE has a mandate for identification and recording for disease surveillance, ICAR and FAO should open a dialogue with OIE to ensure compatibility and uniformity in identification and recording systems with the differing objectives.

Appendix A

Results of a survey conducted by the Animal Identification SC on "Animal identification systems in ICAR member countries"

1. Introduction

In the modern world of agriculture secure, unique identification and reliable and rapid traceability are key factors not only for live animals but also for international trade in animal products. Identification and registration is moving from being voluntary, farmer decided systems to become legislative systems to facilitate disease and chemical residue tracing and control. It is important, that animal producer organisations are able to adapt their systems to meet the demands of animal health authorities, and that these authorities acknowledge the capabilities of systems already in operation.

Accurate and unique identification of animals has been for a long time, the key for:

- Everyday management in the herd.
- Recording of animal production.
- Animal health programmes.
- Breeding programmes.

Now, further important users of animal identification are

- Consumer protection programmes.
- Animal premium programmes.
- Product branding systems.

In January 2003, the ICAR Sub-Committee on Animal Identification circulated a questionnaire on identification systems to all ICAR member organisations. In October 2003, a reminder was sent to all member organisations that had not yet responded to the questionnaire. This Report includes all answers received before January 1, 2004.

The aim of this Report is to reflect the present 'state of the art' regarding animal (cattle; sheep; goat; buffalo) identification systems implemented in ICAR member countries. The results of this survey are not intended to provide recommendations for new systems, however, much inspiration can be derived from looking at existing systems.

Altogether, 100 systems are described in the Report:

Species	Countries	Systems
Cattle	31	39
Sheep	19	28
Goat	20	26
Buffalo	5	7

The systems in general relate to a country or a province, but in Spain the respondent used the opportunity to collect information on all systems used in the above species throughout the country. In Spain there are a total of 41 systems, as each breed society seemed to have its systems, although they were very similar. These systems now are merging into national systems for each species. Similar situations of systems within one country might apply also for other countries.

2. Systems for cattle

Information on the type of system and the level of use of these systems for cattle are given in Table 1.
The table is grouped into World regions and shows type of ID-system, defined as:

Code	Description of Type of ID-system	Answers	
		Number	%
1	Mandatory permanent ID-system for all animals, unique lifetime ID	33	84.6
2	Mandatory permanent ID-system for herdbook animals, unique lifetime ID	3	7.7
3	Mandatory permanent ID-system for disease control, unique lifetime ID	1	2.6
4	Mandatory temporary ID-systems (movement tags)	1	2.6
5	Voluntary ID-systems for herdbook animals, unique lifetime ID	1	2.6

The list also shows the type of legislation covering the systems defined as:

Code	Description of Legislation	Answers	
		Number	%
1	Governmental mandatory ID-system at animal level, no official database	0	0.0
2	Governmental mandatory ID-system and database at animal level	32	82.1
3	Governmental mandatory ID-system at group level, no official database	1	2.6
4	Governmental mandatory ID-system at group level and database	3	7.7
5	No governmental requirements	3	7.7

The completed questionnaires predominantly came from EU countries and those countries that joined the EU in 2004. The EU legislation requires that all cattle are individually and uniquely identified, and that all movements are registered in official databases. It is no surprise that all these countries that responded have governmental mandatory permanent ID-system for all animals, unique lifetime ID and databases at animal level, and that they have 100 percent (or for those joining the EU: nearly 100 percent) animals tagged and registered in the database.
Similar systems are reported from Tunisia, Australia (Victoria), Israel, Switzerland, Canada and Argentina.
Only three identification systems are reported without a database connected.

Table 1. Type of ID systems used for cattle and level of participation.

Reference number	Country	State / Province	World Region	Type of ID-System	Number of animals (1000)	Percent identified	Legislation
75	Sudan		Africa	2			3
78	Sudan		Africa	3			4
81	Sudan		Africa	4			4
87	Tunisia		Africa	1	230	30	2
9	Australia	Victoria	Australasia	1	3 000	95	2
24	New Zealand		Australasia	1	5 500	98	4
10	Austria		EU	1	2 100	100	2
11	Belgium	Flanders, Sanitel	EU	1	3 000	100	2
12	Belgium	Wallone, Sanitel	EU	1	3 000	100	2
13	Belgium	Flanders	EU	1	2 300	100	5
14	Belgium	Wallone	EU	1	3 430	100	2
97	Denmark		EU	1	1 745	100	2
18	Finland		EU	1	1 035	100	2
19	France		EU	1	20 000	100	2
100	Germany		EU	1	14 000	100	2
21	Italy		EU	1	4 200	100	2
25	Portugal		EU	1			2
26	Rep. Ireland		EU	1	2 300	100	2
29	Spain		EU	1	7 742	100	2
30	Sweden		EU	1	1 679		2
32	The Netherlands		EU	1	3 795	100	2
33	UK	N Ireland	EU	1			2
90	UK	Jersey	EU	1	7	100	2
95	Cyprus		EU 2004	1	120		2
96	Cyprus		EU 2004	1	3		2
16	Czech Rep.		EU 2004	1			2
17	Estonia		EU 2004	1	250	95	2
20	Hungary		EU 2004	1	855	100	2
22	Latvia		EU 2004	1	409	95	2
27	Slovakia		EU 2004	1	669	97	2
28	Slovenia		EU 2004	1	490	99	2
15	Croatia		Europe	2	118	54	2
72	Israel		Europe	1	250	100	2
31	Switzerland		Europe	1	2 100		2
86	Turkey		Europe	2	977	9	5
84	Canada		North America	1		100	2
85	Canada	Quebec	North America	1		100	2
23	Mexico		North America	5	70	20	5
8	Argentina		South America	1	350	18	2

2.1. Tagging in cattle

Table 2 shows the resonses relting to tagging of cattle.

Age when tagged is defined as:

Code	Description of age when tagged	Answers	
		Number	%
1	Within seven days from birth	20	54.1
2	Within 20 days from birth	8	21.6
3	Within 30 days from birth	4	10.8
4	Within 60 days from birth	1	2.7
5	Within 180 days from birth	1	2.7
6	Before leaving place of birth	2	5.4
7	Temporary tagging at each movement	1	2.7

In all situations defined by a number of days from birth, it is a prerequisite that animals are tagged before leaving the place of birth.
Applicator of tags is defined as:

Code	Description of who applies tags	Answers	
		Number	%
1	Farmer may apply official tags to the animal	30	78.9
2	Farmer may not apply official tags to the animal	0	0.0
3	Farmer applies preliminary tag – official person later applies official tag	1	2.6
4	Official person must apply all official tags (inspector, veterinarian etc.)	7	18.4

Predominately animals are tagged within 7 days after birth. Only in 5 systems does the tagging occur after 30 days from birth.
82% of the systems require 2 plastic eartags. However, in some countries, one tag is made of plastic and the other tag is made of metal. In three systems there is an option for the farmer to decide the material of one of the tags. Only one system does not require an eartag.
In some systems ear notching, horn branding, tattooing or sketch / photograph are used as supports to tagging.
In 92% of the systems a replacement tag must have the same ID-code as the lost tag. In a few systems the replacement tag has a different number, which is connected to the old tag number through the database. Only Israel reports, that replacement tags are not at all connected to the lost tag.

Table 2. Description of the type of cattle identification tags used in different countries, when applied and who is responsible for application.

Reference number	Country	Age when tagged	Application of tags	Number of tags	Plastic	Metal	Tags same material	Tags different material	Option, one	Ear notching	Horn Branding	Tattooing	Sketch / Photograph	Other1	Same ID at replacement	New connected ID at replacement	New not connected ID at replacement
75	Sudan	1	1	1	X				X	X					X		
78	Sudan	*	3								X	X	X		X		
81	Sudan	7	4	1	X						X	X	X		X		
87	Tunisia	1	4	1	X		X			X					X		
9	Australia	6	1	1	X											X	
24	New Zealand	5	1	2	X	X			X						X		
10	Austria	1	1	2	X		X								X		
11	Belgium	1	1	2	X		X								X		
12	Belgium	1	1	2	X		X								X		
14	Belgium	1	1	2	X		X								X		
97	Denmark	1	1	2	X		X								X		
18	Finland	1	1	2	X		X								X		
19	France	1	1	2	X		X								X		
100	Germany	1	1	2	X		X								X		
21	Italy	1	1	2	X		X								X		
25	Portugal	2	1	2	X		X								X		
26	Rep. Ireland	3	1	2	X		X								X		
29	Spain	2	1	2	X		X								X		
30	Sweden	2	1	2	X		X								X		
32	The Netherlands	1	1	2	X		X								X		
33	UK	1	1	2	X		X								X		
90	UK	1	1	2	X		X								X		
95	Cyprus	1	4	2	X		X							**	X		
96	Cyprus	1	4	1					X							X	
16	Czech Rep.	1	1	2	X	X		X							X		
17	Estonia	2	1	2	X	X				O			O		X		
20	Hungary	2	4	2	X		X								X		
22	Latvia	2	1	2	X		X			O		O			X		
27	Slovakia	1	1	2	X	X	X								X		
28	Slovenia	2	1	2	X		X								X		
15	Croatia	3	4	2	X										X		
72	Israel	1	1	2	X			X									X
31	Switzerland	2	1	2	X		X								X		
86	Turkey	3	4	2	X				X						X		
84	Canada	6	1	2	X		X						***		X		
85	Canada	1	1	2	X		X						***		X		
23	Mexico	3	1	2	X		X								X		
8	Argentina	4	1	1	X							X	X		X		

O: Optional, *: At time of vaccination, **: Plastic Necktag, ***: Herdbook Animals

2.2. Visual ID-codes in cattle

Information on visual ID-codes is shown in Table 3.

In 87% of the systems, visual cattle ID-codes are purely numeric. However, in Sudan, New Zealand and Australia the systems have alphanumeric codes.

In 10% of the systems, the visual ID-code has more than 12 characters. About half of the systems include a check digit in the visual ID-code.

In 36% of the systems, the visual ID-code is just a serial number. In 44%, the visual ID-code contains information about region, in 21% about farm and in 10% about recording organisation.

In 82% of the systems ID-codes are unique at national level, however, Sudan, Cyprus and Argentina have systems that are only unique at the sub-national level.

	Answers	
Types of visual codes	Number	%
Visual ID numeric	34	87
Visual ID alphanumeric	4	10
Check-digit in visual ID	Yes: 16	Yes:41
	No: 7	No: 18
Visual ID purely serial	14	36
Visual ID identifies region	17	44
Visual ID identifies farm	8	20
Visual ID identifies organisation	4	10
Visual ID unique, country	32	82
Visual ID unique, farm	4	10
Visual ID unique, organisation	1	3

Table 3. Description of visual ID-codes used in different countries to identify cattle.

Reference number	Country	State / Province	Visual ID numeric	Visual ID alpha	Visual ID both	Positions in visual ID	Check-digit in visual ID	Visual ID purely serial	Visual ID contains region	Visual ID contains farm	Visual ID contains organisation	Visual ID unique, country	Visual ID unique, farm	Visual ID unique, organisation
	Sudan		X					X		X			X	
78	Sudan			X							X			X
81	Sudan				X		X		X			X		
87	Tunisia		X			10			X			X		
9	Australia	Victoria		X		16	X		X	X		X		
24	New Zealand				X	10				X	X	X		
10	Austria		X			9	X	X				X		
11	Belgium	Flanders, Sanitel	X			9	X		X			X		
12	Belgium	Wallone, Sanitel	X			9	X		X			X		
13	Belgium	Flanders												
14	Belgium	Wallone	X			9	X		X			X		
97	Denmark		X			11	NO			X		X		
18	Finland		X			13	X	X				X		
19	France		X			10	NO		X			X		
100	Germany		X			10	NO		X			X		
21	Italy		X			14	NO		X			X		
25	Portugal		X			9	X		X			X		
26	Rep. Ireland		X			12	X		X	X		X		
29	Spain		X			12	X		X			X		
30	Sweden		X			11	X			X		X		
32	The Netherlands		X			9	X	X				X		
33	UK	N Ireland	X											
90	UK	Jersey	X			12	X		X	X		X		
95	Cyprus		X			4		X					X	
96	Cyprus		X			4		X					X	
16	Czech Rep.		X			9	NO		X			X		
17	Estonia		X			10	X	X				X		
20	Hungary		X			10	X	X				X		
22	Latvia		X			14	NO			X		X		
27	Slovakia		X			12			X		X	X		
28	Slovenia		X			8		X				X		
15	Croatia		X			9	X		X			X		
72	Israel		X			7		X				X		
31	Switzerland		X								X	X		
86	Turkey		X						X			X		
84	Canada		X			8		X				X		
85	Canada	Quebec	X			8		X				X		
23	Mexico		X			9	NO	X				X		
8	Argentina		X					X					X	

2.3. Electronic identification systems in cattle

The responses about use of electronic identification (EID) (Table 4) reflect the situation during 2003, when the EU had not yet decided on its requirements for electronic identification (EID) systems. Table 4 clearly demonstrates, that by 2003, EID has been introduced in official ID systems only in very few countries, such as Australia, New Zealand and Canada. Some responses from EU-countries refer to research trials in the IDEA programme and these are not really officially approved systems. EID has been officially approved in Denmark.

EU approved the ISO standards 11784 and 11785 at the end of 2003. According to ISO standard 11784, the code structure contains a three-digit country code or manufacturer's-code, and a twelve-digit animal ID code, with a space between these codes. Furthermore, the code structure contains a one-digit code for identifying replacement tags. It appears that the two countries that advised that the animal ID code in their country has 16 digits, may have reported on the official ID not the EID.

For countries stating less than 12 digits in the animal ID code, free positions within the twelve-digit code are filled in with zeros in front of the animal ID code.

EID of cattle includes eartags, attachments to eartags or boluses. No countries reported using EID implants.

	Answers	
Type of EID used	Number	%
EID approved	Yes: 10	Yes: 40
	No: 15	No: 60
EID in eartag	5	20
EID in attachment to eartag	3	12
EID in bolus	3	12
EID in implant	0	0

Table 4. Use of electronic cattle identification systems in different countries.

Reference number	Country	State / Province	EID approved	EID in eartag	EID in attachment to eartag	EID in bolus	EID in implant	EID same as visual ID	EID different from visual ID	Positions in EID	Check digit in EID	EID purely serial	EID contains region	EID contains farm
75	Sudan		X		X									
78	Sudan		X		X									
81	Sudan		X			X								
9	Australia	Victoria	X	X		X			X	16	X	X		
24	New Zealand		X	X					X	12			X	
10	Austria		NO											
11	Belgium	Flanders, Sanitel	NO											
12	Belgium	Wallone, Sanitel	NO											
14	Belgium	Wallone	NO											
97	Denmark		X	X				X		11				X
19	France		NO											
21	Italy		X	X		X								
26	Rep. Ireland		NO											
29	Spain		NO											
30	Sweden		NO											
33	UK	N Ireland	NO											
90	UK	Jersey	X		X				X	16	X	X		
16	Czech Rep.		NO											
17	Estonia		NO											
22	Latvia		NO											
15	Croatia		NO											
72	Israel		NO											
84	Canada		X						X					
85	Canada	Quebec	X	X				X						
23	Mexico		NO											

2.4. Movement recording, databases and governmental requirements in cattle

The questionnaire intended to distinguished between recording of movements of groups of animals and recording movement of specific (identifiable) animals (Table 5).

Recording of movement in its simplest form indicates that unspecified animals moved between specified holdings.

Recording of movement of specific animals indicates that specified animals moved between specified holdings.

77% of reported systems have both animals and movements registered in official databases. Especially for herdbook animals, there are also supplementary databases. In addition, farmers in 49% of the systems have to keep on-farm registers. This is the case for all EU countries, even in those countries that did not indicate so in the questionnaire. The responses may indicate that this question was unclear.

79% of all reported systems have to fulfil government requirements on information on both animals and movements.

	Answers	
Movement recording	Number	%
Movement in official database	15	39
Movement at sale yard or auction mart database	6	15
Animal and movement in official database	30	77
Herdbook animal in herdbook database	19	49
Manual farm registers	19	49
Governmental requirements on movements	0	0
Governmental requirements on animals and movements	31	80
No gov requirements	1	3

Table 5. Movement recording and government requirements in different countries.

Reference number	Country	State/Province	Movement in official database	Movement at sale yard or auction mart database	Animal and movement in official database	animal in herdbook	Manual farm registers	Governmental requirements on movements	Gov. requirements on animals and movements	No gov requirements
75	Sudan					X				
78	Sudan				X				X	
81	Sudan		X				X		X	
87	Tunisia				X	X	X		X	
9	Australia	Victoria	X	X	X				X	
24	New Zealand				X	X			X	
10	Austria		X		X	X	X		X	X
11	Belgium	Flanders, Sanitel		X	X		X		X	
12	Belgium	Wallone, Sanitel		X	X		X		X	
13	Belgium	Flanders				X				
14	Belgium	Wallone				X			X	
97	Denmark				X		X		X	
18	Finland				X	X	X		X	
19	France		X		X				X	
100	Germany		X		X	X	X		X	
21	Italy		X		X	X			X	
25	Portugal				X		X		X	
26	Rep. Ireland			X	X	X	X		X	
29	Spain		X		X				X	
30	Sweden				X				X	
32	The Netherlands		X		X	X			X	
33	UK	N Ireland	X		X	X	X		X	
90	UK	Jersey			X	X	X		X	
95	Cyprus				X		X		X	
96	Cyprus				X		X		X	
16	Czech Rep.		X							
17	Estonia				X	X	X		X	
20	Hungary		X		X				X	
22	Latvia		X		X		X		X	
27	Slovakia		X	X	X					
28	Slovenia				X				X	
15	Croatia		X	X	X	X	X		X	
72	Israel		X			X	X		X	
31	Switzerland				X					
86	Turkey					X				
84	Canada				X	X				
85	Canada	Quebec							X	
23	Mexico					X				
8	Argentina				X		X		X	

2.5. Information for traceability in cattle

Each row in Table 6 represents a reported system. Table 6 shows the information that must be recorded in each system. Some systems are based on government requirements and other systems are herdbook systems.

Usually in systems designed just for traceability of animals you do not have to report the sire of the animal, but in herdbook systems you, of course, must record this information.

Systems with no information other than the dates of movements and maybe previous and next farm are systems designed just to indicate lines of trade between herds.

Information recorded for each animal	Answers	
	Number	%
Place of origin	31	82
Date of birth	34	90
Breed	31	82
Sex	32	84
Mother	30	79
Father	17	45
Date of entry	35	92
Previous farm	29	76
Date of departure	33	87
Next farm	25	66
Other	7	18

Table 6. Information recorded in different countries to assist traceability of cattle.

Reference number	Country	State/ Province	Place of origin	Date of birth	Breed	Sex	Mother	Father	Date of	Previuos farm	Date of departure	Next farm	Other	
75	Sudan		X	X	X	X	X	X	X	X	X	X		
78	Sudan								X	X				
81	Sudan		X	X	X				X	X	X	X		
87	Tunisia		X	X	X	X	X	X	X	X	X	X	1	
9	Australia	Victoria		X					X	X	X	X		From 2004
24	New Zealand			X	X	X	X	X	X	X	X			Dairy cattle
10	Austria		X	X	X	X	X	X	X	X	X	X		From gov
11	Belgium	Flanders, Sanitel	X	X		X	X		X	X	X			
12	Belgium	Wallone, Sanitel	X	X		X	X		X	X	X			
13	Belgium	Flanders	X	X	X	X	X	X		X			3	
14	Belgium	Wallone	X	X	X	X	X	X	X	X	X	X		
97	Denmark		X	X	X	X	X	X	X	X	X	X		
18	Finland		X	X	X	X	X	X	X	X	X	X		
19	France		X	X	X	X	X	O	X	X		X		
100	Germany		X	X	X	X	X		X		X		4	
21	Italy		X	X	X	X	X		X	X	X	X		
25	Portugal		X	X	X	X	X		X	X	X	X		
26	Rep. Ireland		X	X	X	X	X		X	X	X	X		From gov
29	Spain		X	X	X	X	X		X	X	X	X		
30	Sweden		X	X	X	X	X		X	X	X	X		
32	The Netherlands		X	X	X	X	X		X	X	X	X		
33	UK	N Ireland		X	X	X								
90	UK	Jersey	X	X	X	X	X	X	X	X	X	X		
95	Cyprus		X	X	X	X	X	X	X		X			
96	Cyprus		X	X	X	X	X		X		X			
16	Czech Rep.		X	X	X	X	X	X	X	X	X	X		
17	Estonia		X	X	X	X	X	X	X	X	X	X		
20	Hungary		X	X	X	X	X		X		X	X	2	
22	Latvia		X	X	X	X	X	X	X	X	X	X		
27	Slovakia		X	X	X	X	X		X	X	X	X	1, 3	
28	Slovenia		X						X	X	X	X	2	
15	Croatia		X	X	X	X	X	X		X		X		
72	Israel		X	X	X	X			X		X			
31	Switzerland		X	X	X	X	X	X	X		X		2, 3	
86	Turkey			X	X	X	X	X	X	X	X	X		
84	Canada								X		X			
85	Canada	Quebec		*	*	*	*	*	X		X			
8	Argentina		X	X	X	X	X	X	X	X	X	X		

3. Systems for sheep

Information on the type of system and the level of use of these systems for sheep are shown in Table 7.
The table is grouped into World regions and shows type of ID-system, defined as:

Code	Description of system	Answers	
		Number	%
1	Mandatory permanent ID-system for all animals, unique lifetime ID	16	57
2	Mandatory permanent ID-system for herdbook animals, unique lifetime ID	9	32
3	Mandatory permanent ID-system for disease control, unique lifetime ID	2	7
4	Mandatory temporary ID-systems (movement tags)	1	4
5	Voluntary ID-systems for herdbook animals, unique lifetime ID	0	0

The table also shows the type of legislation covering the systems defined as:

Code	Description of legislation	Answers	
		Number	%
1	Governmental mandatory ID-system at animal level, no official database	3	11
2	Governmental mandatory ID-system and database at animal level	17	61
3	Governmental mandatory ID-system at group level, no official database	3	11
4	Governmental mandatory ID-system at group level and database	4	14
5	No governmental requirements	1	4

Again the completed questionaires predominantly came from EU countries and from those countries that joined the EU in 2004.
The diversity of systems for sheep is larger than for cattle, but still the animals have unique lifetime IDs in 96% of reported systems.
Systems with no databases (legislation code 1 or 3) are more frequent than in cattle.

Table 7. Type of ID system used for sheep and level of participation in different countries.

Reference number	Country	State/Province	World Region	Type of ID-System	Number of animals (1000)	Percentage	Legislation
76	Sudan		Africa	2			3
79	Sudan		Africa	3			4
82	Sudan		Africa	4			4
88	Tunisia		Africa	1	230	30	2
52	Austria		EU	2			1
53	Austria		EU	1			3
54	Belgium	Flanders, Sanitel	EU	2	4	100	2
55	Belgium	Flanders	EU	2	4		2
56	Belgium	Flanders	EU	2	40	100	2
57	Belgium	Wallone	EU	2	40	100	2
58	Belgium	Wallone, Sanitel	EU	1	200	90	4
98	Denmark		EU	1	201	100	2
61	France		EU	1	14,000	95	1
62	France		EU	2	1,280	18	2
73	Germany		EU	2			5
64	Italy		EU	1	4,200	100	2
66	Portugal		EU	3			1
69	Spain		EU	1	24,300	100	3
70	Sweden		EU	1	426		4
59	Czech Rep.		EU 2004	1			2
60	Estonia		EU 2004	1	24	70	2
63	Hungary		EU 2004	1	970	92	2
65	Latvia		EU 2004	1	16	95	2
67	Slovakia		EU 2004	1	253	70	2
68	Slovenia		EU 2004	2	15	16	2
91	Cyprus		EU 2004	1	1		2
93	Cyprus		EU 2004	1	3		2
71	Switzerland		Europe	1	2,1		2

3.1. Tagging in sheep

Table 8 shows the responses relating to tagging of sheep.
Age when tagged is defined as:

		Answers	
Code	Description of age when tagged	Number	%
1	Within seven days from birth	10	39
2	Within 20 days from birth	3	12
3	Within 30 days from birth	2	8
4	Within 60 days from birth	4	15
5	Within 180 days from birth	2	8
6	Before leaving place of birth	4	15
7	Temporary tagging at each movement	1	4

In all situations defined by a number of days from birth, it is a prerequisite, that animals are tagged before leaving the place of birth.
Applicater of tags is defined as:

		Answers	
Code	Description of who applies tags	Number	%
1	Farmer may apply official tags to the animal	17	61
2	Farmer may not apply official tags to the animal	0	0
3	Farmer applies preliminary tag – official person later applies official tag	4	14
4	Official person must apply all official tags (inspector, veterinarian etc.)	7	25

The age of sheep when tagged varies quite considerably, and it is more usual for official persons / inspectors to apply the tag(s).
54% of the systems use only one plastic eartag. 32% use two plastic eartags. Nearly all systems use plastic eartags. However, in some countries, one tag is made of plastic and the other tag is made of metal. In three systems there is an option for the farmer to decide the material of the tags. Only one system does not require an eartag.
In some systems, ear notching, horn branding, tattooing or sketch / photograph are used as supports to tagging.
In 79% of all systems a replacement tag must have the same ID-code as the lost tag. In two systems the replacement tag has a different number, which is connected to the old tag number through the database. In three systems, the replacement tags are not connected to the lost tag.

Table 8. Description of the type of tags used in different countries, when applied and who is responsible for application.

Reference number	Country	Age	Application of tags	Number of tags	Plastic	Metal	Same material	Different material	Option, one	Option, all	Ear notching	Horn Branding	Tattooing	Sketch/Photograph	Same ID at replacement	New connected ID at replacement	New not connected ID at replacement
76	Sudan	1	1	1	X				X		X				X		
79	Sudan	*	3									X	X	X	X		
82	Sudan	7	4	1	X							X	X	X	X		
88	Tunisia	1	4	2	X		X				X				X		
52	Austria	1	3	**	X	X				X					X		
53	Austria	6	1	1	X	X				X					X		
54	Belgium	4	1	1	X										X		
55	Belgium		1	1	X										X		
56	Belgium	4	1	1	X										X		
57	Belgium	1	1	1	X										X		
58	Belgium	5	1	1	X												X
98	Denmark	4	1	2	X		X								X		
61	France	1	1	2	X												X
62	France	1	4	2	X								O		X		
73	Germany	3	1	2	X		X										
64	Italy	1	1	2	X		X						X		X		
66	Portugal	5	4	1	X												X
69	Spain	6	1	1	X										X		
70	Sweden	6	1	2	X	X		X							X		
59	Czech Rep.	1	1	2	X	X		X							X		
60	Estonia	2	1	1	X										X		
63	Hungary	6	4	1	X										X		
65	Latvia	2	1	2	X		X				O		O		X		
67	Slovakia	4	3	1	X		X						O		X		
68	Slovenia	3	3	2	X								O			X	
91	Cyprus	1	4	1	X		X				X		X		X		
93	Cyprus	1	4	1	X		X									X	
71	Switzerland	2	1	2	X		X								X		
0	Option																
*	Vaccination																
**	1 or 2 tags optional																

3.2. Visual ID-codes in sheep

Information on visual ID-codes in sheep is shown in table 9.
In 79% of the systems, visual sheep ID-codes are numeric. However, a number of systems have alphanumeric (i.e. both numeric and alpha) characters.
In 4 systems the visual ID-code has more than 12 characters. Only 3 systems include a check digit in the visual ID-code.
In 21% of the systems the visual ID-code is just a serial number. In the remainder, the visual ID code contains information about region, farm or recording organisation.
75% of the systems have unique ID-codes at national level, however, Sudan, Austria, Germany and Cyprus have systems that are only unique at the sub-national level.

Type of ID codes	Number	%
Visual ID numeric	22	79
Visual ID alphanumeric	6	22
Check-digit in visual ID	Yes: 3	Yes: 11
	No: 8	No: 29
Visual ID purely serial	6	21
Visual ID identifies region	12	43
Visual ID identifies farm	12	43
Visual ID identifies organisation	5	18
Visual ID unique, country	21	75
Visual ID unique, farm	4	14
Visual ID unique, organisation	2	7

Table 9. Description of visual ID-codes used in different countries to identify sheep.

Reference number	Country	State/Province	Visual ID numeric	Visual ID alpha	Visual ID both	Positions in visual ID	Check-digit in visual ID	Visual ID purely serial	Visual ID contains region	Visual ID contains farm	Visual ID contains organisation	Visual ID unique, country	Visual ID unique, region	Visual ID unique, farm	Visual ID unique, organisation
76	Sudan		X					X		X				X	
79	Sudan			X							X				X
82	Sudan				X		X		X			X			
88	Tunisia		X			10			X			X			
52	Austria		X			9	X		X			X			
53	Austria		X			7		X						X	
54	Belgium	Flanders, Sanitel			X	9				X	X	X			
55	Belgium	Flanders	X			8			X	X		X			
56	Belgium	Flanders			X	9				X	X	X			
57	Belgium	Wallone	X			8	NO			X		X			
58	Belgium	Wallone, Sanitel	X			8	NO		X			X			
98	Denmark		X			11	NO			X		X			
61	France		X			13	NO		X	X		X			
62	France		X		Tattoo	13	NO		X	X		X			
73	Germany				X			X							X
64	Italy		X			14	NO		X	X		X			
66	Portugal		X			8			X			X			
69	Spain				X	12				X					
70	Sweden		X			10						X			
59	Czech Rep.		X			9	NO		X			X			
60	Estonia		X			10	X	X				X			
63	Hungary		X			10			X	X		X			
65	Latvia		X			14	NO			X		X			
67	Slovakia		X			9			X		X	X			
68	Slovenia		X									X			
91	Cyprus		X			4		X						X	
93	Cyprus		X			4		X						X	
71	Switzerland		X								X	X			

3.3. Electronic identification systems in sheep

The responses to the questionnaire about use of electronic identification (Table 10) reflect the situation during 2003, when the EU had not yet decided on its requirements for electronic identification (EID) systems. Some responses from EU-countries refer to trials in the IDEA programme and these are not really officially approved systems. EID has been officially approved in Denmark.

EU approved the ISO standards 11784 and 11785 at the end of 2003. According to ISO standard 11784, the code structure contains a three-digit country code / manufacturer's-code and a twelve-digit animal ID code, with a space between these codes. Furthermore, the code structure contains a one-digit code for identifying replacement tags.

For countries stating less than 12 digits in the animal ID code, free positions within the twelve-digit code are filled in with zeros in front of the animal ID code.

EID of sheep includes eartags, attachments to eartags or boluses. No countries reported using EID implants.

	Answers	
Summary of answers	Number	%
EID approved	Yes: 6 No:14	Yes: 30 No: 70
EID in eartag	2	10
EID in attachment to eartag	2	10
EID in bolus	2	10
EID in implant	0	0

Table 10. Use of electronic sheep identification systems in different countries.

Reference number	Country	State/Province	EID approved	EID in eartag	EID in attachment to eartag	EID in bolus	EID in implant	EID same as visual ID	EID different from visual ID	Positions in EID	Check digit in EID	EID purely serial	EID contains region	EID contains farm	EID contains organisation
76	Sudan		X		X										
79	Sudan		X		X										
82	Sudan		X			X									
52	Austria		NO												
53	Austria		NO												
54	Belgium	Flanders, Sanitel	NO												
55	Belgium	Flanders	NO												
56	Belgium	Flanders	NO												
57	Belgium	Wallone	NO												
58	Belgium	Wallone, Sanitel	NO												
98	Denmark		X	X				X		11				X	
61	France		NO												
62	France		NO												
64	Italy		X	X		X									
69	Spain		NO												
70	Sweden		X												
59	Czech Rep.		NO												
60	Estonia		NO												
63	Hungary		NO												
65	Latvia		NO												

3.4. Movement recording, databases and governmental requirements in sheep

The questionnaire intended to distinguish between recording of movements of groups of animals and recording of movement of specific (identifiable) animals.
Recording of movement in its simplest form is that unspecified animals moved between specified holdings.
Recording of movement of specific animals is that specified animals moved between specified holdings.
Each row in table 11 represents one system only, so it was expected that systems where both animals and movements were in one database (column 6), there would have been no indications saying that movements were kept in an official database (column 4). The double answers may indicate, that there are in fact more than one database in the system (maybe a farmer owned and a government owned), and that the information in those two databases may not be exactly the same. Government databases need some information for traceability, whereas farmer owned databases need also information on production, classification etc. etc.
The picture is more diverse than for cattle. The reason for this is, that many sheep systems register movements of groups of animals.
11% of the systems have no governmental requirements, 18% have requirements to register movements of groups of animals and 46% of the systems require recording of movements of specific animals.

	Answers	
Summary of answers	Number	%
Movement in official database	7	25
Movement at sale yard or auction mart database	0	0
Animal and movement in official database	11	39
Herdbook animal in herdbook database	11	39
Manual farm registers	16	57
Governmental requirements on movements	5	18
Governmental requirements on animals and movements	13	46
No gov requirements	3	11

Table 11. Movement recording for sheep and government requirements in different countries.

Reference number	Country	State / Province	Movement in official database	Movement at saleyard / auction mart	Animal and movement in official database	Herdbook animal in herdbook database	Manual farm registers	Gov require on movements	Gov require on animals and movements	No gov requirements
76	Sudan					X				
79	Sudan				X				X	
82	Sudan		X				X		X	
88	Tunisia				X	X	X		X	
52	Austria					X	X			X
53	Austria						X			X
54	Belgium	Flanders, Sanitel			X					
55	Belgium	Flanders	X			X			X	
56	Belgium	Flanders	X			X			X	
57	Belgium	Wallone				X			X	
58	Belgium	Wallone, Sanitel						X		
98	Denmark				X		X		X	
61	France						X			
62	France					X	X			
73	Germany					X	X	X		
64	Italy		X		X	X			X	
66	Portugal							X		
69	Spain						X	X		
70	Sweden						X		X	
59	Czech Rep.		X							
60	Estonia				X		X		X	
63	Hungary		X		X		X		X	
65	Latvia		X		X		X		X	
67	Slovakia				X	X	X			X
68	Slovenia					X				
91	Cyprus				X		X		X	
93	Cyprus						X	X		
71	Switzerland				X					

3.5. Information for traceability in sheep

Each row in table 12 represents a reported system. Table 12 shows the information that must be recorded in each system. Some systems are based on government requirements and other systems are herdbook systems. Usually in systems designed just for traceability of animals you do not have to report the sire of the animal, but in herdbook systems you, of course, must record this information.
Systems with no information other than the dates of movements and maybe previous and next farm are systems designed to indicate lines of trade between herds.

	Answers	
Information recorded for each animal	Number	%
Place of origin	21	88
Date of birth	20	83
Breed	19	79
Sex	19	79
Mother	17	71
Father	15	63
Date of entry	22	92
Previuos farm	19	79
Date of departure	22	92
Next farm	20	83
Other	4	17

Table 12. Information recorded in different countries to assist traceability for sheep.

Reference number	Country	State / Province	Place of origin	Date of birth	Breed	Sex	Mother	Father	Date of entry	Previuos farm	Date of departure	Next farm	Other
76	Sudan		X	X	X	X	X	X	X	X	X	X	
79	Sudan								X	X			
82	Sudan		X	X	X				X	X	X	X	
88	Tunisia		X	X	X	X	X	X	X	X	X	X	Veterinary information
52	Austria		X	X	X	X	X	X	X	X	X	X	
55	Belgium	Flanders	X	X	X	X	X	X	X	X	X	X	
56	Belgium	Flanders	X	X	X	X	X	X		X		X	
57	Belgium	Wallone	X	X	X	X	X	X	X	X	X	X	
58	Belgium	Wallone, Sanitel	X	X		X			X	X	X	X	
98	Denmark		X	X	X	X	X	X	X	X	X	X	
62	France		X	X	X	X	X	X	X	X	X	X	Culling reason
73	Germany			X	X	X	X	X	X		X		
64	Italy		X	X	X	X	X		X	X	X	X	
69	Spain								X	X	X	X	
70	Sweden		X	X					X	X	X	X	
59	Czech Rep.		X	X	X	X	X	X	X	X	X	X	
60	Estonia		X	X	X	X	X	X	X	X	X	X	
63	Hungary		X	X	X	X			X		X	X	
65	Latvia		X	X	X	X	X	X	X	X	X	X	
67	Slovakia		X	X	X	X	X	X	X	X	X	X	
68	Slovenia		X								X	X	Culling reason
91	Cyprus		X	X	X	X	X	X	X	X	X	X	
93	Cyprus		X		X	X	X		X		X		
71	Switzerland		X	X	X	X	X	X	X		X		Colour, Culling reason

4. Systems for goats

Information on the type of system and the level of use of these systems for goats are given in table 13.
The table is grouped into World regions and shows type of ID-system, defined as:

		Answers	
Code	Description of type of ID-system	Number	%
1	Mandatory permanent ID-system for all animals, unique lifetime ID	15	58
2	Mandatory permanent ID-system for herdbook animals, unique lifetime ID	8	31
3	Mandatory permanent ID-system for disease control, unique lifetime ID	2	8
4	Mandatory temporary ID-systems (movement tags)	1	4
5	Voluntary ID-systems for herdbook animals, unique lifetime ID	0	0

The table also shows the type of legislation covering the systems, defined as:

		Answers	
Code	Description of system	Number	%
1	Governmental mandatory ID-system at animal level, no official database	3	12
2	Governmental mandatory ID-system and database at animal level	14	54
3	Governmental mandatory ID-system at group level, no official database	3	12
4	Governmental mandatory ID-system at group level and database	4	15
5	No governmental requirements	2	8

Again the completed questionnaires predominantly came from EU countries and from those countries that joined the EU in 2004.
The situation for goats is very much the same as for sheep. The animals in 96% of the reported systems have unique lifetime IDs. Only one system was reported without, lifetime Ids and that is a system with temporary tags for moving the animals.
Systems with no databases (legislation code 1 or 3) are more frequent than in cattle.

Table 13. Type of ID systems used for goats and level of participation.

Reference number	Country	State / Province	World Region	Type of ID-System	Number of animals (1000)	Percentage	Legislation
77	Sudan		Africa	2			3
80	Sudan		Africa	3			4
83	Sudan		Africa	4			4
89	Tunisia		Africa	1	230	30	2
34	Austria		EU	2			1
35	Austria		EU	1			3
36	Belgium	Flanders	EU	2	4		2
37	Belgium	Wallone	EU	2	4	100	2
38	Belgium	Wallone, Sanitel	EU	1	200	90	4
99	Denmark		EU	1	19	100	2
41	France		EU	1	2,000	90	1
42	France		EU	2	310	35	2
44	Italy		EU	1	4,200	100	2
46	Portugal		EU	3			1
49	Spain		EU	1	3,114	100	3
50	Sweden		EU	1	5		4
51	Switzerland		EU	1	2,100		2
39	Czech Rep.		EU 2004	1			2
40	Estonia		EU 2004	1	1	50	2
43	Hungary		EU 2004	2	11	20	5
45	Latvia		EU 2004	1	4	95	2
47	Slovakia		EU 2004	1	3	6	2
48	Slovenia		EU 2004	2	3	10	2
92	Cyprus		EU 2004	1	1		2
94	Cyprus		EU 2004	1	3		2
74	Canada		North America	2			5

4.1. Tagging in goats

Table 14 shows the responses relating to on tagging of goats.
Age when tagged is defined as:

		Answers	
Code	Description of age when tagged	Number	%
1	Within seven days from birth	11	46
2	Within 20 days from birth	3	13
3	Within 30 days from birth	1	4
4	Within 60 days from birth	2	8
5	Within 180 days from birth	3	13
6	Before leaving place of birth	3	13
7	Temporary tagging at each movement	1	4

In all situations defined by a number of days from birth, it is a prerequisite that animals are tagged before leaving the place of birth.

Applicater of tags is defined as:

		Answers	
Code	Description of who applies tags	Number	%
1	Farmer may apply official tags to the animal	15	60
2	Farmer may not apply official tags to the animal	0	0
3	Farmer applies preliminary tag – official person later applies official tag	4	16
4	Official person must apply all official tags (inspector, veterinarian etc.)	6	24

The age of goats when tagged varies quite considerably, and it is more usual for official persons / inspectors to apply the tags.
54% of the systems use only one plastic eartag. 27% use two plastic eartags. 92% of all systems use plastic eartags. However, in some countries one tag is made of plastic and the other tag is made of metal. In one system there is an option for the farmer to decide the material of the tags. Only one system does not require eartag.
In some systems, ear notching, horn branding, tattooing or sketch / photograph are used as supports to tagging.
In 77% of all systems a replacement tag must have the same ID-code as the lost tag. In two systems the replacement tag has a different number, which is connected to the old tag number through the database. In three systems, the replacement tags are not connected to the lost tag.

Table 14. Description of the type of tags used in different countries, when applied and who is responsible for applications.

Reference number	Country	Age	Application of tags	Number of tags	Plastic	Metal	Same material	Different material	Option, one	Option, all	Plastic tape	Ear notching	Horn Branding	Tattooing	Sketch/ Photograph	Same ID at replacement	New connected ID at replacement	New not connected ID at replacement
77	Sudan	1	1	1	X				X			X				X		
80	Sudan	*	3										X	X	X	X		
83	Sudan	7	4	1	X								X	X	X	X		
89	Tunisia	1	4	2	X		X					X				X		
34	Austria	1	3	1 or 2	X	X				X						X		
35	Austria	6	1	1	X	X				X						X		
36	Belgium	5	1	1	X											X		
37	Belgium	1	1	1	X											X		
38	Belgium	5	1	1	X													X
99	Denmark	4	1	2	X		X									X		
41	France	1	1	1	X													X
42	France	1	1	2	X									O		X		
44	Italy	1	1	2	X		X							X		X		
46	Portugal	5	4	1	X													X
49	Spain	6	1	1	X											X		
50	Sweden	6	1	2	X	X		X								X		
51	Switzerland	2	1	2	X		X									X		
39	Czech Rep.	1	1	2	X	X		X								X		
40	Estonia	2	1	1	X											X		
43	Hungary	1	4	1	X									X		X		
45	Latvia	2	1	2	X		X					O		O		X		
47	Slovakia	4	3	1	X		X							O		X		
48	Slovenia	3	3	2	X									O			X	
92	Cyprus	1	4	1	X		X					X		X		X		
94	Cyprus	1	4	1	X		X										X	
74	Canada													X				
*	Vaccination																	

4.2. Visual ID-codes in goats

Information on visual ID-codes is shown in table 15.
In 85% of goat ID-systems, the visual goat ID-codes are numeric. However, a number of systems have alphanumeric (i.e. both numeric and alpha) characters.
In three systems the visual ID-code has more than 12 characters. 15% of the systems include a check digit in the visual ID-code.
In the majority of systems the visual ID-code contains information about region, farm or recording organisation. 23% of the systems have visual ID-codes with only serial numbers.
77% of the systems have unique ID-codes at national level, however, Sudan, Austria and Cyprus have systems that are only unique at the sub-national level.

	Answers	
Type of ID Codes	Number	%
Visual ID numeric	22	85
Visual ID alpha numeric	4	15
Check-digit in visual ID	Yes: 4	Yes: 15
	No: 8	No: 31
Visual ID purely serial	6	23
Visual ID identifies region	11	42
Visual ID identifies farm	10	39
Visual ID identifies organisation	3	12
Visual ID unique, country	20	77
Visual ID unique, farm	4	15
Visual ID unique, organisation	2	8

Table 15. Description of visual ID - codes used in different countries to identify goats.

Reference number	Country	State/Province	Visual ID numeric	Visual ID alpha	Visual ID both	Positions in visual ID	Check-digit in visual ID	Visual ID purely serial	Visual ID contains region	Visual ID contains farm	Visual ID contains organisation	Visual ID unique, country	Visual ID unique, region	Visual ID unique, farm	Visual ID unique, organisation
77	Sudan		X					X		X				X	
80	Sudan			X							X				X
83	Sudan				X		X		X			X			
89	Tunisia		X			10			X			X			
34	Austria		X			9	X		X			X			
35	Austria		X			7		X						X	
36	Belgium	Flanders	X			8			X	X		X			
37	Belgium	Wallone	X			8	NO			X		X			
38	Belgium	Wallone, Sanitel	X			8	NO		X			X			
99	Denmark		X			11	NO			X		X			
41	France		X			13	NO		X	X		X			
42	France		X		Tattoo	12	NO		X	X		X			
44	Italy		X			14	NO		X	X		X			
46	Portugal		X			8			X			X			
49	Spain				X	12				X					
50	Sweden		X			10						X			
51	Switzerland		X								X	X			
39	Czech Rep.		X			9	NO		X			X			
40	Estonia		X			10	X	X				X			
43	Hungary		X			10	X	X				X			
45	Latvia		X			14	NO			X		X			
47	Slovakia		X			9			X		X	X			
48	Slovenia		X									X			
92	Cyprus		X			4		X						X	
94	Cyprus		X			4		X						X	
74	Canada				X					X		X			X

4.3. Electronic identification systems in goats

The responses to the questionnaire about use of electronic identification for goats (Table 16) reflect the situation during 2003, when EU had not yet decided on its requirements for electronic identification (EID) systems. Some responses from EU-countries refer to trials in the IDEA programme and these are not really officially approved systems. EID has been officially approved in Denmark.

EU approved the ISO standards 11784 and 11785 at the end of 2003. According to ISO standard 11784, the code structure contains a three-digit country code / manufacturer's-code and a twelve-digit animal ID code, with a space between these codes. Furthermore, the code structure contains a one-digit code for identifying replacement tags.

For countries stating less than 12 digits in the animal ID code, free positions within the twelve-digit code are filled in with zeros in front of the animal ID code.

EID of goats includes eartags, attachments to eartags or boluses. No countries reported using EID implants.

	Answers	
Type of EID devices	Number	%
EID approved	Yes: 6	Yes: 35
	No: 11	No: 65
EID in eartag	2	12
EID in attachment to eartag	2	12
EID in bolus	2	12
EID in implant	0	0

Table 16. Use of electronic identification systems for goats in different countries.

Reference number	Country	State/Province	EID approved	EID in eartag	EID in attachment to eartag	EID in bolus	EID in implant	Other2	EID same as visual ID	EID different from visual ID	Positions in EID	Check digit in EID	EID purely serial	EID contains region	EID contains farm	EID contains organisation
77	Sudan		X		X											
80	Sudan		X		X											
83	Sudan		X			X										
34	Austria		NO													
35	Austria		NO													
36	Belgium	Flanders	NO													
37	Belgium	Wallone	NO													
38	Belgium	Wallone, Sanitel	NO													
99	Denmark		X	X					X		11				X	
42	France		NO													
44	Italy		X	X		X										
49	Spain		NO													
50	Sweden		X													
39	Czech Rep.		NO													
40	Estonia		NO													
43	Hungary		NO													
45	Latvia		NO													

4.4. Movement recording, databases and governmental requirements in goats

The questionnaire intended to distinguish between recording of movements of groups of animals and recording movement of specific (identifiable) animals.
Recording of movement in its simplest form is that unspecified animals moved between specified holdings.
Recording of movements of specific animals is that specified animals moved between specified holdings.
Each row in table 17 represents one system only, so it was expected that systems where both animals and movements were in one database (column 6), there would have been no indications saying that movements were kept in an official database (column 4). The double answers may indicate, that there are in fact more than one database in the system (maybe a farmer owned and a government owned), and that the information in those two databases may not be exactly the same. Government databases need some information for traceability, whereas farmer owned databases need also information on production, classification etc. etc.
The picture is more diverse than for cattle. The reason for this is, that many goat systems register movements of groups of animals.
Six systems have no governmental requirements, four have requirements to register movements of groups of animals and eleven systems require recording movements of specific animals.

	Answers	
Summary of answers	Number	%
Movement in official database	5	19
Movement at sale yard or auction mart database	0	0
Animal and movement in official database	9	35
Herdbook animal in herdbook database	10	39
Manual farm registers	14	54
Governmental requirements on movements	4	15
Governmental requirements on animals and movements	11	42
No gov requirements	5	19

Table 17. Movement recording for goats and government requirements in different countries.

Reference number	Country	State/Province	Movement in official database	Movement at saleyard/auction mart	Animal and movement in official database	Herdbook animal in herdbook database	Manual farm registers	Gov require on movements	Gov require on animals and movements	No governmental requirements
77	Sudan					X				
80	Sudan				X				X	
83	Sudan		X				X		X	
89	Tunisia				X	X	X		X	
34	Austria					X	X			X
35	Austria						X			X
36	Belgium	Flanders	X			X			X	
37	Belgium	Wallone				X			X	
38	Belgium	Wallone, Sanitel						X		
99	Denmark				X		X		X	
41	France						X			
42	France					X	X			
44	Italy		X		X	X			X	
46	Portugal							X		
49	Spain						X	X		
50	Sweden						X		X	
51	Switzerland				X					
39	Czech Rep.		X							
40	Estonia				X		X		X	
43	Hungary									X
45	Latvia		X		X		X		X	
47	Slovakia				X	X	X			X
48	Slovenia					X				
92	Cyprus				X		X		X	
94	Cyprus						X	X		
74	Canada					X				X

4.5. Information for traceability in goats

Each row in table 18 represents a reported system. Table 18 shows the information that must be recorded in each system. Some systems are based on government requirements and other systems are herdbook systems. Usually in systems designed just for traceability of animals you do not have to report the sire of the animal, but in herdbook systems you, of course, must record this information.
Systems with no information other than the dates of movements and maybe previous and next farm are systems designed just to indicate lines of trade between herds. Such systems are not much used in cattle. However in sheep and goats they are quite often used.

	Answers	
Information recorded for each animal	Number	%
Place of origin	19	91
Date of birth	17	81
Breed	16	76
Sex	16	76
Mother	15	71
Father	13	62
Date of entry	19	91
Previuos farm	17	81
Date of departure	19	91
Next farm	17	81
Other	3	14

Table 18. Information recorded in different countries to assist traceability of goats.

Reference number	Country	State / Province	Place of origin	Date of birth	Breed	Sex	Mother	Father	Date of entry	Previuos farm	Date of departure	Next farm	Other
77	Sudan		X	X	X	X	X	X	X	X	X	X	
80	Sudan								X	X			
83	Sudan		X	X	X				X	X	X	X	
89	Tunisia		X	X	X	X	X	X	X	X	X	X	Veterinary information
34	Austria		X	X	X	X	X	X	X	X	X	X	
36	Belgium	Flanders	X	X	X	X	X	X	X	X	X	X	
37	Belgium	Wallone	X	X	X	X	X	X	X	X	X	X	
38	Belgium	Wallone, Sanitel	X	X		X			X	X	X	X	
99	Denmark		X	X	X	X	X	X	X	X	X	X	
44	Italy		X	X	X	X	X		X	X	X	X	
49	Spain								X	X	X	X	
50	Sweden		X	X					X	X	X	X	
51	Switzerland		X	X	X	X	X	X	X		X		Colour, Culling reason
39	Czech Rep.		X	X	X	X	X	X	X	X	X	X	
40	Estonia		X	X	X	X	X	X	X	X	X	X	
45	Latvia		X	X	X	X	X	X	X	X	X	X	
47	Slovakia		X	X	X	X	X	X	X	X	X	X	
48	Slovenia		X								X	X	Culling reason
92	Cyprus		X	X	X	X	X	X	X	X	X	X	
94	Cyprus		X		X	X	X		X		X		
74	Canada		X	X	X	X	X	X					

5. Systems for buffalo

Information on the type of system and the level of use of these systems for buffalo are given in table 19.
The table is grouped into World regions and shows type of ID-system, defined as:

1. Mandatory permanent ID-system for all animals, unique lifetime ID.
2. Mandatory permanent ID-system for herdbook animals, unique lifetime ID.
3. Mandatory permanent ID-system for disease control, unique lifetime ID.
4. Mandatory temporary ID-systems (movement tags).
5. Voluntary ID-systems for herdbook animals, unique lifetime ID.

The table also shows the type of legislation covering the systems, defined as:

1. Governmental mandatory ID-system at animal level, no official database.
2. Governmental mandatory ID-system and database at animal level.
3. Governmental mandatory ID-system at group level, no official database.
4. Governmental mandatory ID-system at group level and database.
5. No governmental requirements.

Again the completed questionnaires predominantly came from EU countries and from those countries joined the EU in 2004.
The systems are much like the systems cattle.

Table 19. Type of ID systems used for buffalo and level of participation.

Reference number	Country	State / Province	World Region	Type of ID-System	Number of animals	Percentage	Legislation
1	Austria		EU	1	2,100	100	2
2	Belgium	Flanders, Sanitel	EU	1	3,000	100	2
3	Belgium	Wallone, Sanitel	EU	1	3,000	100	2
4	Belgium	Wallone	EU	1	3,430	100	2
6	Italy		EU	1	4,200	100	2
7	Spain		EU	1	7,742	100	2
5	Hungary		EU 2004	1	855	100	2

5.1. Tagging in buffalo

Table 20 shows the responses relating to tagging of buffaloes.
Age when tagged is defined as:
1. Within seven days from birth
2. Within 20 days from birth
3. Within 30 days from birth
4. Within 60 days from birth
5. Within 180 days from birth
6. Before leaving place of birth
7. Temporary tagging at each movement

In all situations defined by a number of days from birth, it is a prerequisite that animals are tagged before leaving the place of birth.
Applicater of tags is defined as:
1. Farmer may apply official tags to the animal
2. Farmer may not apply official tags to the animal
3. Farmer applies preliminary tag – official person later applies official tag
4. Official person must apply all official tags (inspector, veterinarian etc.)

Again the systems are much like the systems for cattle.

Table 20. Description of the type of tags used in different countries, when applied to buffalo and who is responsible for application.

Reference number	Country	Age	Application of tags	Number of tags	Plastic	Metal	Same material	Different material	Option, one	Option, all	Plastic tape	Ear notching	Horn Branding	Tattooing	Sketch / Photograph	Same ID at replacement	New connected ID at replacement	New not connected ID at replacement
1	Austria	1	1	2	X		X									X		
2	Belgium	1	1	2	X		X									X		
3	Belgium	1	1	2	X		X									X		
4	Belgium	1	1	2	X		X									X		
6	Italy	1	1	2	X		X									X		
7	Spain	2	1	2	X		X									X		
5	Hungary	2	4	2	X		X									X		

5.2. Visual ID-codes in buffalo

Information on visual ID-codes in buffalo is shown in table 21.
Visual buffalo ID-codes are all numeric in the reported systems
In one system the visual ID-code has more than 12 characters. Most systems include a check digit in the visual ID-code.
In most systems the visual ID-code contains information about region, farm or recording organisation. Only in two reported systems is the visual ID-code just a serial number.
All ID-codes are unique at national level.

Table 21. Description of visual ID-codes used in different countries to identify buffalo.

Reference number	Country	State / Province	Visual ID numeric	Visual ID alpha	Visual ID both	Positions in visual ID	Check-digit in visual ID	Visual ID purely serial	Visual ID contains region	Visual ID contains farm	Visual ID contains organisation	Visual ID unique, country	Visual ID unique, region	Visual ID unique, farm	Visual ID unique, organisation
1	Austria		X			9	X	X				X			
2	Belgium	Flanders, Sanitel	X			9	X		X			X			
3	Belgium	Wallone, Sanitel	X			9	X		X			X			
4	Belgium	Wallone	X			9	X		X			X			
6	Italy		X			14	NO		X			X			
7	Spain		X			12	X		X			X			
5	Hungary		X			10	X	X				X			

5.3.Electronic identification systems in buffalo

The limited data provided regarding electronic identification of buffaloes is included in Table 22.

Table 22. Use of electronic identification systems for buffalo in different countries.

Reference number	Country	State / Province	EID approved	EID in eartag	EID in attachment to eartag	EID in bolus	EID in implant	EID same as visual ID	EID different from visual ID	Positions in EID	Check digit in EID	EID purely serial	EID contains region	EID contains farm	EID contains organisation
1	Austria		NO												
2	Belgium	Flanders, Sanitel	NO												
3	Belgium	Wallone, Sanitel	NO												
4	Belgium	Wallone	NO												
6	Italy		X	X		X									
7	Spain		NO												
5	Hungary														

5.4. Movement recording, Databases and governmental requirements in buffalo

The questionnaire intended to distinguish between recording of movements of groups of animals and recording movement of specific (identifiable) animals.
Recording of movement in its simplest form is that unspecified animals moved between specified holdings.
Recording of movement of specificanimals is that specified animals moved between specified holdings.
Each row in table 23 represents one system only, so it was expected that systems where both animals and movements were in one database (column 6), there would have been no indications saying that movements were kept in an official database (column 4). The double answers may indicate, that there are in fact more than one database in the system (maybe a farmer owned and a government owned), and that the information in those two databases may not be exactly the same. Government databases need some information for traceability, whereas farmer owned databases need also information on about production, classification etc. etc.
All systems have to fulfil government requirements on information on both animals and movements.

Table 23. Movement recording for buffalo and government requirements in different countries.

Reference number	Country	State / Province	Movement in official database	Movement at saleyard / auction mart	Animal and movement in official database	Herdbook animal in herdbook database	Manual farm registers	Gov require on movements	Gov require on animals and movements	No gov requirements
1	Austria		X		X	X	X		X	
2	Belgium	Flanders, Sanitel		X	X		X		X	
3	Belgium	Wallone, Sanitel		X	X		X		X	
4	Belgium	Wallone				X			X	
6	Italy		X		X	X			X	
7	Spain		X		X				X	
5	Hungary		X		X				X	

5.5. Information for traceability in buffalo

Each row in table 24 represents a reported system. Table 24 shows the informatioon that must be recorded in each system. Some systems are based on government requirements and other systems are herdbook systems. Usually in systems designed just for traceability of animals you do not have to report the sire of the animal, but in herdbook systems you, of course, must record this information.
Systems with no information other than the dates of movements and maybe previous and next farm are systems designed just to indicate lines of trade between herds.

Table 24. Information recorded in different countries to assist traceability of buffalo.

Reference number	Country	State / Province	Place of origin	Date of birth	Breed	Sex	Mother	Father	Date of entry	Previuos farm	Date of departure	Next farm	Other3
1	Austria		X	X	X	X	X	X	X	X	X	X	
2	Belgium	Flanders, Sanitel	X	X		X	X		X	X	X		
3	Belgium	Wallone, Sanitel	X	X		X	X		X	X	X		
4	Belgium	Wallone	X	X	X	X	X	X	X	X	X	X	
6	Italy		X	X	X	X	X		X	X	X	X	
7	Spain		X	X	X	X	X		X	X	X	X	
5	Hungary		X	X	X	X	X		X		X	X	Culling reason

Form of the questionnaire

Country: **State/Province:**

Organisation:

Contact person:

Phone: **Fax:** **E-mail:**

Species	
Cattle	☐
Sheep	☐
Goat	☐
Buffalo	☐

Type of Identification system **(One answer only)**	
Mandatory permanent ID-system for all animals, unequivocal lifetime ID	☐
Mandatory permanent ID-system for herdbook animals, unequivocal lifetime ID	☐
Mandatory permanent ID-system for disease control programme, unequivocal lifetime ID	☐
Mandatory temporary ID-systems (movement tags)	☐
Voluntary ID-systems for herdbook animals, unequivocal lifetime ID	☐
Voluntary ID-systems for herdbook animals, ID code may change by movement	☐
Voluntary ID-systems for management purposes, unequivocal lifetime ID	☐
Voluntary ID-systems for management purposes, ID code may change by movement	☐

Approximate number of animals in this identification system:
Identified animals of potential animals for the is identification system (percentage):

Legislation

(One answer only)

Governmental mandatory ID-system at animal level (individual codes), no official database ☐
Governmental mandatory ID-system and database at animal level ☐

Governmental mandatory ID-system at group level (farm / herd codes), no official database ☐
Governmental mandatory ID-system at group level and database ☐

No governmental requirements ☐

Age of animal when tagged

(One answer only)

Within 7 days from birth ☐
Within 20 days from birth ☐
Within 30 days from birth ☐
Within 60 days from birth ☐
Within 180 days from birth ☐
Before leaving the place of birth ☐
Temporary tagging at each movement ☐
Other, please specify ☐

Application of tags

(One answer only)

Farmer may apply official tags to the animal ☐
Farmer may not apply official tags to the animal ☐
Farmer applies preliminary tag – official person later applies official tag ☐
Official person must apply all official tags (inspector, veterinarian etc.) ☐

Types of conventional non-electronic tags

(More than one answer required for eartags)

Number of eartags applied per animal ☐
Plastic eartag ☐
Metal eartag ☐

In case of two or more eartags applied per animal:

All eartags must of same material (plastic or metal) ☐
Eartags must be of different materials (plastic and metal) ☐
Material optional for one of the eartags ☐
Material optional for all of the eartags ☐

Pre-printed plastic tape ☐

Ear notching ☐
Horn branding ☐
Tattooing ☐
Sketching / Photograph ☐

Other, please specify ☐

Types of electronic tags

(More than one answer possible)

Is electronic identification approved in the identification system ☐

Electronic devices used:
Electronic ID in eartag (moulded into male or female part the eartag) ☐
Electronic ID in attachment to eartag (device not moulded into the eartag) ☐
Electronic ID in bolus ☐
Electronic ID in implants ☐

Other, please specify ☐

Visual Animal ID code (Country code NOT included)

(More than one answer required)

Visual ID-code is purely numeric ☐
Visual ID-code is purely alphanumeric ☐
Visual ID-code contains both numeric and alphanumeric characters ☐

Number of positions in the visual ID-code (possible check digit included) ☐
Check digit included in the visual ID code ☐

Visual ID-code is just a serial number (possible check digit included) without further information ☐
Visual ID-code contains information about region ☐
Visual ID-code contains information about farm ☐
Visual ID-code contains information about recording organisation ☐

Visual ID-code is unique at country level ☐
Visual ID-code is unique at region level ☐
Visual ID-code is unique at farm level ☐
Visual ID-code is unique at recording organisation level ☐

Electronic Animal ID code structure (Country code NOT included)

(More than one answer required)

The electronic ID code is the same as the visual animal ID code ☐
The electronic ID code is different from the visual animal ID code ☐

Number of positions in the electronic ID-code (possible check digit included) ☐
Check digit included in the electronic ID code ☐

Electronic ID-code is just a serial number (possible check digit included) without further information ☐
Electronic ID-code contains information about region ☐
Electronic ID-code contains information about farm ☐
Electronic ID-code contains information about recording organisation ☐

Replacement tag

(One answer only)

Same ID-code as in the lost original tag ☐
New ID-code connected to the lost original tag ☐
New ID-code with no connection to the lost original tag ☐

Traceability

(More than one answer possible)

Information on movements for all animals is kept in official databases (check also option nr. 3!!) ☐
Information on movements is kept in saleyards / auction marts databases ☐

Information on animals and movements for all animals is kept in official databases ☐
Information on herdbook animals is kept in herdbook databases ☐
Information on animals and movements is kept in manual farm registers ☐

Governmental bodies require registration of movements only ☐
Governmental bodies require registration of animals and movements ☐
Governmental bodies do not require registration of animals and movements ☐

Information required by recording agency from the farmer for traceability of animals

(More than one answer required)

Code for place of origin ☐
Date of birth ☐
Breed ☐
Sex ☐

Mother ☐
Father ☐

For incoming animal: Date of movement to farm ☐
For incoming animal: Code of previous farm ☐

For outgoing animal: Date of movement from farm ☐
For outgoing animal: Code of next farm ☐
Other information (please specify) ☐

No information required from farmer ☐

Organisations answering the questionnaire

Country, Region	Organisation and contact person	Reference numbers
Argentina 1	Asociación Criadores de Holando Argentino Sra. Liliana Chazo Phone: 54-11–4805-7323 Fax: 54–11–4805–7323 E-mail: info@acha.org.ar	8
Australia, Victoria 2	ADHIS Robert Poole Phone: +61 3 96428066 Fax: +61 3 96428166 E-mail: rpoole@adhis.com.au	9
Austria 3	Federation of Austrian Cattle Breeders Dr. Ernst Potucek Phone: +43 1 334 17 21 Fax: +43 1 334 17 13 E-mail: potucek@zar.at	1, 10, 52
Austria 3	Österr. Bundesverband für Schafe und Ziegen Mag. Margit Schmidt Phone: +43 1 333 87 98 22 Fax:+43 1 333 87 98 25 E-mail:oebsz@aon.at	34, 35, 53
Belgium, Wallone 4	Ministére de la Région Wallone Ir J.F. DUCKERTS Phone: +32.81.234.913 Fax: +32.81.234.813 E-mail: jf.duckerts@mrw.wallonie.be	4, 14, 37, 57
Belgium, Wallone 4	SANITEL (CDV-ACSA) Dir. Dr. J.M. ROBIJNS Phone: +32 2 208 41 65 Fax: +32 2 208 41 51 E-mail: jean-marie.robijns@cdv-acsa.be	3, 12, 38, 58
Belgium, Flanders 4	SANITEL (CDV-ACSA) Dir. Dr. J.M. ROBIJNS Phone: +32 2 208 41 65 Fax:+32 2 208 41 51 E-mail: jean-marie.robijns@cdv-acsa.be	2, 11, 54
Belgium, Flanders 4	Ministerie van de Vlaamse Gemeenschap Ir. Stan Van den Maegdenbergh Phone: 02 / 208 35 72 Fax: 02 / 208 35 65 E-mail: stan.van.den.maegdenbergh@cmlag.fgov.be	13, 55
Belgium, Flanders 4	Nationale Verbond van Geiten- en Melkschapenfokkers vzw Dhr. W. Van der AA Phone: +32.11.25.52.81 Fax:+32.11.25.52.81	36

Country, Region	Organisation and contact person	Reference numbers
Belgium, Flanders 4	Nationale Vereniging van Kwekers van Vleesschapen vzw Dhr. I. Lootvoet Phone: +32.58.28. 98.20 Fax:+32.58.28.98.21 E-mail: i.lootvoet@skynet.be	56
Canada 5	Canadian Goat Society Sharon Hunt Phone: 613-731-9894 Fax: 613-731-0704 E-mail: cangoatsoc@travel-net.com	74
Canada 5	Canadian DHI Barry Russell Phone: 506-857-9131 Fax: 506-855-0456 E-mail: brussell@adlic.ca	84, 85
Croatia 6	Croatian Livestock Selection Centre B.Sc. Ante Pezo Phone: ++385 / 1 / 3903-154 Fax:++385 / 1 / 3903-192 E-mail: hssc@zg.hinet.hr	15
Cyprus 7	Agricultural Research Institute Andreas P. Mavrogenis and C. Constantinou Phone: +357-22403121 Fax: +357-22316770 E-mail: mavrogen@arinet.ari.gov.cy	91, 93,95
Cyprus 7	Department of Agriculture Takis Antoniou, PhD Phone: +357-22408639	92, 94, 96
Czech Republic 8	Czech-Moravian Breeder's Corporation Vaclav Cermak Phone: +420 257 740 337 Fax: +420 257 740 617 E-mail: cermak@cmsch.cz	16, 39, 59
Denmark 9	Danish Cattle Federation Ole Klejs Hansen Phone: +45-87405295 Fax: +45-87405089 E-mail: okh@landscentret.dk	97, 98, 99
Estonia 10	Estonian Animal Recording Centre Aire Pentjärv Phone: +372 7 387 700 Fax: + 372 7 387 702 E-mail: aire.pentjarv@reg.agri.ee	17, 40, 60
Finland 11	ProAgria Maaseutukeskusten Liitto (Association of Rural Advisory Centres) Mr Juho Kyntäjä Phone:+358 40 517 6972 Fax: +358 9 4174 0400 E-mail: juho.kyntaja@maaseutukeskus.fi	18

Country, Region	Organisation and contact person	Reference numbers
France 12	Institut de l'Elevage Hervé LEDOS Phone: 33 (0)2 99 14 86 26 Fax:33 (0)2 99 14 87 55 E-mail: herve.ledos@inst-elevage.asso.fr	19
France 12	Institut de l'Elevage Jacques HOLTZ Phone: 33 (0)5 61 75 44 50 Fax: 33 (0)5 61 73 85 91 E-mail: jacques.holtz@inst-elevage.asso.fr	41, 61
France 12	Institut de l'Elevage Jean-Paul SIGWALD Phone: 33 (0)1 40 04 53 19 Fax : 33 (0)1 40 04 49 50 E-mail: eric.jullien@inst-elevage.asso.fr	42
France 12	Institut de l'Elevage Eric JULLIEN (meat sheep) Phone: 33 (0)1 40 04 53 29 Fax : 33 (0)1 40 04 49 50 E-mail: eric.jullien@inst-elevage.asso.fr Jean-Michel ASTRUC (dairy sheep) Phone: 33 (0)5 61 28 51 65 Fax: 33 (05) 61 73 85 91 E-mail: jean-michel.astruc@inst-elevage.asso.fr	62
Germany 13	German Cattle Breeders Federation Dr. Reinhard Pauw, Klaus Ditting Phone: 0049-228-91447-27 Fax: 0049-228-91447-11 E-mail: Klaus.ditting@adt.de	100
Germany 13	German Sheep Breeders federation Dr. Stefan Völl Phone: 1149-228-375351 Fax: 0049-228-376449 E-mail: s.voell@bauernverband.de	73
Hungary 14	National Institute for Agricultural Quality Control Dr. Sebestyén, Sándor Phone: +36-1-212-31-27 / 2219 Fax:+36-1-212-55-02 E-mail: sebestyens@ommi.hu	5, 20, 43, 63
Ireland 15	Irish Cattle Breeding Federation Soc. Ltd Brian Wickham Phone: +353-23-20212 Fax: +353-23-20229 E-mail: bwickham@icbf.com	26
Israel 16	ICBA Boaz Hanochi Phone: 972-4-6279743 Fax: 972-4-6273501 E-mail: hmb-hboaz@icba.org.il	72

Country, Region	Organisation and contact person	Reference numbers
Italy 17	Associazione Italiana Allevatori (A.I.A.) Dr. Mauro Fioretti – Dr. Corrado Bracciaferri Phone: +39-0685451-307 or -301 Fax:+390685451322 E-mail: fioretti.m@aia.it or bracciaferri.c@aia.it	6, 21, 44, 64
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Mexico 19	Holstein de México A.C. Dr. Felipe Ruiz López Phone: +52 442 212 02 69 Fax: +52 442 224 39 33 E-mail: holstein@prodigy.net.mx	23
New Zealand 20	Livestock Improvement Corporation LTD. Ian Hook Phone: 0064 7 856 0700 Fax: 0064 7 856 0625 E-mail: ihook@lic.co.nz	24
Portugal 21	Direcção Geral de Veterinãria Mário Costa Phone: 217808206 Fax:217956066 E-mail:bioucas@hotmail.com	25, 46, 66
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Sudan 25	Ministry of Animal Resources And Fisheries Dr. Mohamed Sir Elkhatim A / Allateif Phone: 024911465847 Fax: 024911475996 E-mail: kitoum1@hotmail.com	75, 76, 77, 78, 79, 80, 81, 82,83
Sweden 26	Swedish Board of Agriculture Eva-Marie Stålhammar Phone: +46 36 15 58 22 Fax: +46 36 30 81 82	30, 50, 70
Switzerland 27	Arbeitsgemeinschaft Schweizerischer Rinderzüchter Hans Künzi Phone: 41 31 381 42 01 Fax: +41 31 382 08 80 E-mail: asr-bern@bluewin.ch	31, 51, 71
The Netherlands 28	NRS ing. Ite Hamming Phone: 00 31 26 3898784	32
Tunisia 29	Office de l'Elevage et des Pâturages Mustapha Guellouz Phone: +216-71-782960 Fax: +216-71-793603 E-mail: dg.oep@email.ati.tn	87, 88, 89
Turkey 30	Cattle Breeders Association of Turkey Cagla Yüksel Kaya Phone: +90-312-4256880 Fax: +90-312-4187685 E-mail: dsymb@dsymb.org.tr	86
UK, Northern Ireland 31	United Dairy Farmers Ltd Brian Hunter Phone: 028 9037 2237 Fax:028 9037 2222 E-mail: bhunter@utdni.co.uk	33
UK, Jersey 31	Department of Agriculture and Fisheries Alan Treanor Phone: 01534-866200 Fax: 01534-866201 E-mail: alant@nmr.co.uk	90