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ICAR Working group on AI & other relevant technologies

SURVEY ON RECORDING AND VALIDATION OF BOVINE A.I. DATA AMONG SOME ICAR MEMBER COUNTRIES

AI is an essential information among those used for genetic evaluation purposes. It comes just after identification and before parentage recording. Without accurate AI recording, records on parentage are hardly precise and then accuracy of genetic evaluations are bad. Besides, AI records are important for quality controls in AI stations and reproduction management of herds, along with other important data.

Duty of the ICAR Working Group on AI& other relevant technologies (AI &ORT), according to it's term of reference, is to set up recommendations in order to improve world wide records used for genetic evaluations.

The survey presented below is the summary of the work done between 1999 and 2002 by the group. Members of the group were experts of the AI industry of eight countries important in the world AI and/or technically advanced in processing and utilising of AI data:

Name	Organization	Country
G. Doak	NAAB	USA
H. Gustafson	Swedish Un. or Agric. Science	Sweden
V.Ramakhishnan	LIC	New Zealand
A. Malafosse (Chairman)	UNCEIA	France
C.S. Schaefer	ADR	Germany
F. Pizzi	Universita di Milano	Italy
G de Jong	CR Delta	The Netherlands
U. Witschi	S.V.K.B.	Switzerland

To achieve it's goal the group used the following method :

- ✓ A questionnaire was build up by the chairman and sent to the members some weeks before each meeting.
- ✓ Each of the members answered any question and a new questionnaire with individual answers was send back to the members some days before the meeting.
- ✓ It was then put on discussion during the meeting: explanations and clarifications were necessary.
- ✓ After validation of answers a summary on the chapter was done by the chairman and proposed to the group for validation along with the new questions to be answered.

It should be mentioned that the answering of the various questionnaires was not easy and depending on the degree of integration of AI data into the zootechnical data processing systems of the various countries.

Five topics have been be covered:

TOPIC	DETAILS
A General principles	<ul style="list-style-type: none"> ➤ Needs for AI recording ➤ Key points for assessing the confidence range of AI accuracy
B Recording of AI data	<ul style="list-style-type: none"> ➤ General organisation and information recorded ➤ Various requirement among countries according to cow populations & operators
C Processing and validation	<ul style="list-style-type: none"> ➤ AI Data flow ➤ Tests
D Tools implemented	<ul style="list-style-type: none"> ➤ Automatic recording systems ➤ Integrated databases Id, registration, AI, milking records ➤ Quality controls
E Integration and use of AI data in the genetic data systems	<ul style="list-style-type: none"> ➤ Genetic evaluation ➤ Herd-Book keeping & pedigrees printing

A General principles

AI data are recorded for various purposes, requiring various degrees of accuracy for their use. Validation of AI data with the chosen confidence range of accuracy, requires various processes including recording of other herd data, organisation and completeness of recording . It depends on the further use of AI data (especially parentage & genetic evaluations).

AI data have various uses: they are used either for management purposes either for genetic purposes. Management use is relevant from farmer point of view (reproduction of individual cows or for the herd) or from the AI Centre point of view (NRR of bulls, technician activity etc..).By genetic use it is understood the use for parentage recording assessment, registration &Herd-Book keeping, genetic evaluation for fertility (genetic evaluation for any trait is linked with registration & parentage recording). Details will be given in chapter C

For each purpose a specific degree of accuracy is needed, and control have to be carried out with regards to specific herd, animal, or events data (inventory, dates, and etc.). Table 1 is presenting the general picture of this issue starting from technical events in herds to recording of specific data.

From the general organisation point of view, the experience of countries made evidence that:

- AI are recorded before birth in any country
- Parentage recordings take simultaneously in account AI records and natural service records for the same herds
- Data are recorded by people not belonging to the farm when non-DIY
- All AI are recorded whatever they are successful or not, in term of pregnancy
- AI data are usually checked against herd files or bull files with identification of any animal
- Batches of semen units are traced from the AI processing centre to the cow in some countries such as the Netherlands, Sweden & Switzerland.
- Birth and AI recording systems are integrated in most countries
- Quality of the system of AI –birth-registration-parentage recording is secured in most countries by systems of blood typing or DNA fingerprints.

Table 1

Needs for recording AI data according to their utilisation and the degree of accuracy requested.

STEPS	Biological or Technical Events in Herds	Purposes for recording	Field of utilisation	Data recorded.
1	A particular cow is starting her pregnancy on a given day in a particular herd.(*)	>Herd reproduction >Individual management of reproduction by cow.	Management	1) >Precise inventory of the herd: In & out date for each breeding stock Calves stillborn >Registration of AI (fecundating)dates and Calving dates.
2	The sire used for this mating is known.	>Direct fertility of bulls >Fertility of bull's daughters >Female fertility?	IA station management Bulls genetic evaluation. Same for cows?	AI bulls identification, semen available in farmers or operator's containers, operator registration 1)+(Female + AI date +calving date): + link female-sire-date- herd.
3	A calf (or calves) is (are) born out of this mating and pregnancy.	Parentage recording of calves.	Genetic evaluation for any trait. Herd Book keeping (To accept animals in the breed) Pedigrees printing	Births recording ,date & birth conditions, calf and mother registration (+ sire if not recorded previously)

(*) Reproduction events may be listed as : heat detection vs oestrus synchronisation or induction, AI performing, pregnancy confirmation

B Recording of AI data

Concerning AI data, the description of existing situations was concentrated on technical aspects. In order to clarify the discussion some general statements have been set up i.e. price fixing and billing were excluded from discussion.

Moreover to have a better overview on data recorded in different countries, it was asked to specify the items recorded according to the various operators who perform AI and categories of herds in which the data are recorded

According to operators and herds the following classification can be set up:

- Classification of operators who performs AI:
 - Farmers (D.I.Y.)
 - Employed technicians (or vets or persons acting under contract)
 - Free lance technicians (or vets)
- Various types of herds
 - Commercial herds
 - Performance recorded herds (or test herds)
 - Herd-Book or H-B registered herds (or pedigree herds)
 - Other specialised herds

The set of items recorded and the accuracy of recording could varies in different situations due to the use of AI data

1. Information recorded

In table 2 are summarised the answers from different countries (France, Germany, Italy, the Netherlands, Sweden, Switzerland, USA). In boxes are indicated, for each item (Herd, Date of AI, Cow, Bull, Semen, Rank of AI, and other data such as AI on oestrus synchronisation, diseases etc) and according to type of herds and operators, the number of countries that have mentioned that a particular item is recorded. In France and in Italy there is no distinction between Herd book and performance recorded herds.

From these data we can have a picture of minimum recording data for AI: identification-number of herds, date of AI, operator identification, bull identification number are systematically recorded.

Cow identification is not systematically recorded by farmers, station technicians or freelance operators. When cow identification is not recorded by AI operators it is probably the duty of other operators as milk-recording technicians.

It was difficult to make a significant distinction in AI data recording between the various categories of herds: the indicated differences are more reflecting the various form of organisation of AI among the countries. In the Netherlands all herds are subjected to the same recording system. Cow identification is routinely recorded by AI technicians in performance registered herds for milk or beef production and the Herd-Book herds. In a few countries females identification is routinely registered in commercial herds.

It should be mentioned that besides the more relevant items, very few countries are recording more informative data for other purposes than parentage recording.

Table 2		RECORDS FOR AI ACCORDING TO COW POPULATIONS & OPERATORS								
		(to be recorded or not on forms in the farm)								
		COMMERCIAL HERDS			Perform. recorded herds			Pedigree or HB Herds		
		Farmers	Sation techn.	Free lanc. op	Farmers	Sation techn.	Free lanc. op	Farmers	Sation techn.	Free lanc. op
	Id official N°(or national N°)	6	5	4	4	3	2	3	3	3
HERD	AI Station internal n°	3	2	1	3	2	1	2	2	2
	Name/Adress..	4	3	2	4	3	2	2	2	2
DATE of AI		6	6	3	4	3	2	3	3	3
OPERATOR	Status(Farmer, technician..)	5	4	3	3	3	2	2	2	2
	Id N° (<u>intern</u> ;national)	6	5	3	3	3	2	3	3	3
	Working or tag ID N°	4	5	2	3	3	2	1	1	1
	Official ID N° (or H-B N°)	3	3	2	3	3	2	3	3	3
	Name	3	3	2	2	2	2	1	1	1
COW	Breed	3	3	2	2	2	2	2	2	2
	Registred in HB	2	1			1	1			
	Birth date	4	3	2	1	2	2	1	1	1
	Calving rank	3	2	1		2				
	Stud	3	3	2	1	3	3	1	1	1
	Breed	4	4	3	3	4	3	3	3	3
BULL	Working or tag ID N°	3	3	2	2	3	1			
	Official ID N° (or H-B N°)	5	5	2	3	4	3	3	3	3
	Name	4	4	3	3	4	3	2	2	2
	Reference(collection date)	2	3	1	2	3	2	2	1	2
SEMEN	Collecting centre	1	1		1	1	1	1	1	1
	Spec.charact.(fresh,dilution, <u>splited unit</u>)	2	4	2	3	3	2	2	2	2
	Location(farmer or technician container)	3	4	1	3	3	1	2	1	1
RANK of AI		3	3	1	2	2	1	1	1	1
	AI on oestrus synchronisation	2	4			1			1	1
	Ability for cow to be bred	2	3			1				
O. DATA	Diseases	2	2							
	Double AI	2	4			2			1	
	Reference of AI station		1			1				
	Semen status (ownership..)		1			1				

2. Various requirement according to cow populations & operators

The answers concerning the requirements of AI data are shown in table 3. AI data are recorded compulsory in all countries except in New-Zealand. In some countries the minimum content is defined by regulation, but in most of them it is a professional agreement. It can be observed that a minimum of data is defined in all the countries. The harmonisation of the forms is adopted in most of the countries.

Table 3

COUNTRIES	Some data Recorded Compulsory?	How the minimum is defined			Harmonisation of forms
		Regulation	Professional Agreement	No minimum	
France	Y	Y	Y		N
Germany	Y	Y	Y		N
Holland	Y		Y		Y
Italy	Y	Y			Y
Sweden	Y	Y	Y		Y
Switzerland	Y		Y		Y
U S A	Y		Y		N
New-Zealand	N		Y		

C. Processing and validation of data

The process of AI data before validation includes several steps including a description of data flow, of kind of tests to be carried out and the description of the use of AI data. In some countries test have to take into account the legislation on AI.

Schemes describing flow of data from the farm to the various databases were given for France, Germany Italy, the Netherlands, Switzerland, the USA. In most countries AI data are processed first at the station level, then sent to data bases where there are integrated to the other technical data coming out of the records on farm.

Three types of test for data validation can be carried out, with various accuracy or severity, according to the final use of AI data:

- **Completeness** (are all items available for the process that has to be carried out ?),
- **Coherence** (are items recorded for processing of AI data have been already referenced?),
- **Likelihood** (could the recorded event occur or not according to already existing information?)

Those tests can be carried out at various levels:

- Farm: farmer's computer or technician computer
- AI station
- Data computing centres where AI information is integrated to the other genetic information in zootechnical data bases.

Table 4 on next page summarises the answers of the members. It should be mentioned that a "cross = x" means that a majority of members indicated that the test was carried out in their countries.

Table 4

Completeness of data		Coherence of data		Likelihood of AI event	
ITEMS (from table2)	Chk	EXISTING FILES	Chk		Chk
Herd	x	Herds (or clients)	x	Active herd	x
Date of AI	x		x	Compatible with .previ dates	x
Operator	x	Operators (employees or not)	x	Was on duty the day of AI	x
Cow	x	Cow tag/ off ID N°/is a female Exists in the herd Conditions on age	x x x	Referenced in the herd on the day of AI	x
Bull	x	AI Bulls	x	Recognised as active bull	x
Semen	x	Semen Reference	x	Available in technician or farmers container	x
Rank of AI	x			Rank of AI compatible with previous ranks	x
Calving data	x			Previous calving or calving following AI compatible with AI date	x
Other data					

Use of AI data

According to general principles describe in part A (Table 1), three basic type of use of AI data have to be mentioned:

- **AI station management** including:
 - Establishment of statistics by a given time period, bull, breed, area, operator, farm, rank of AI etc
 - Computing of non-return-rates (operator, breed, bull, period,...)
 - Interface with bookkeeping, keeping of semen stocks, etc
- **Integration with genetic data systems:**
 - Parentage recording of calves born out of those AI and their registration
 - Genetic evaluation for fertility (direct, indirect)
 - Herd-book keeping and printing of pedigrees
- **Management of reproduction of herd or of individual cow**
 - Fertility alarms indicators
 - Fertility summarises (rates of pregnancy, calving intervals etc)
 - History of the reproductive live of cows.

To run those tests **some tools have to be implemented**. Tests have also to be carried out in some countries to take into account the legislation on AI.

The situation in the home countries of groups members is the following :

- A data dictionary for AI officially published in all countries for genetic use of AI (with the exception of the USA)
- In most countries there are not requirements by law on the registration of AI (with the exception of France and Italy). In Germany & the Netherlands there are guidelines to record the AI data.
- In most countries AI bulls are officially referenced either by the breed associations,(Switzerland, the Netherlands, USA, Italy) either by an another national body (France) or licensed by the legal authorities (Germany, France). The AI stations that deliver semen or the semen traders have to use bulls witch are referenced.

There are not strict management to keep records of semen movements in farmer's container on D-I-Y in most countries (exception: France). In countries where an integrated system of zootechnical records exist, AI technician use the herd inventory (paper or electronic files) for AI registration when the registration of the inseminated female is requested. If it doesn't exist there are no special efforts to keep inventory of inseminated females. In New Zealand it is done on a voluntary basis.

D. Tools implemented

To help data management and process, some tools have been implemented in some countries. At first automatic systems have been set up to make easier the work of technician and to give value to data they have collected on farm. On the other hand when AI data are incorporated to the other zootechnical data in integrated databases, extra values may be give to the all system.

1. Automatic recording systems

In some countries automatic recording systems such as micro-computers (laptops) have been implemented at the technician level. But the situation differs among the countries. The present situation can be described as follows:

Today, AI centres of very few countries have implemented automatic recording systems in respect to AI data.

Inseminators, who use these system, are equipped with micro-computers (laptops) or more and more with P D A (palm pilot devices). These are connected with AI station data processing system or with national zootechnical databases.

In order to achieve an overview of the implemtd system a survey was started. Several Countries were asked to list the reason for implementing such system. Table 5 indicates the responses after clarification.

Countries	France	Italy	Holland	C.H	Swe	Ger
Save money, in cutting administrative costs	4	5	1	5	3	1
Less administrative work for AI technicians: <i>Billing</i> <i>Book-keeping</i> <i>Management of semen stocks</i>	1	4	1	5	1	4
Improving speed for AI data processing	2	1	1	4	4	5
Improving quality of AI records	3	2	1	3	4	2
Developing services to farmers <i>Reproduction, fertility management</i> <i>Breeding and genetics: matting plans, optimisation of use of available semen</i>	5	3	5	2	2	3

Another task was the identification of bull on straws. A single country, namely The Netherlands, uses bar codes to record bull identification on straws along with herd and cow identification when recording AI.

The information on databases, which are used by AI technicians on their microcomputers, vary among the countries and can be summarised as follows:

It can be related to a daily round. In such a case only data of farmers visited by technicians at a given day are belonging to the database. These have to be up-dated every night. An identical situation occurs when technicians are uploading their hand computer every day.

In some cases data of a given group of farms are provided to the technician. These are updated on a regular base (day, week, month).

When AI is organised in groups of inseminators or teams, they are using the same data base.

Depending on the work and services the technician will provide at herd or home level, the data base of it's microcomputer contains more or less information.

To get records of AI with a good level of accuracy the database must contain identification of cows and AI bulls. Cows belonging to the data base are either all the cows of a given area (group of herds) or cows that have to be inseminated during a given period. In this case it is uploaded from a central data base.

A good reproduction service at technician's level means that historical data of cows are available (all AI in a given period, birth data, pregnancy diagnose, health situation, production average). This situation is rather rare (France).

The access to genetic values is also possible in some countries.

A good administrative management at farm level means that semen stock management, billing and accounting can be done on technicians computers (France)

The survey also shows, that ordering the semen or the AI service is done mainly by voice recorders. Some countries are thinking about the use of the internet for such purposes.

The usual way for transmitting recorded data from technician microcomputer to the central data base is a modem with a rather frequent transmission (day).

Before leaving the farm the technician has to provide the farmer with a form with recorded information on AI in most countries. In the other countries, records are send back to the farmer along with other forms such as bills.

The survey also showed that sometimes technicians have to fill out sheets at the herd level to record their activity.

In sophisticated systems the technician provides document after recording the data at farm level.

He may also provide a list with additional information (cows to check, pregnancies, oestrus synchronisation, mating advises etc)

The degree of importance varies enormously among the countries, in which they are implemented. It ranges from 0% to 80%.

2. Integrated databases

AI data belong to larger zootechnical systems data such as identification reproduction and genetics and are processed along with other data for various purposes. Therefore, integrated data bases have been set up in some countries.

In most countries AI data are processed by the AI centres and then sent to zootechnical data bases where they are also used for other purposes.

Some system fully integrate the AI data in the database. This is done by the direct uploading into the zootechnical data base. Tests are carried out and AI data are reckoned valid or not. The data base is usually up-dated in a daily round.

In some cases the routine exchange is done by AI organisation .

Most of the data bases are used by numerous users from various organisations. It could be observed that such system offer precise data because mistakes or failures are detected more frequently. This is obvious for identification/registration data.

In case technicians from various technical organisations are equipped with microcomputers it can be observed that they use the same data base in order to rend services to the farmers. Of course this situation means that a strong political agreement has been set up among those organisations. If technicians don't use the same data base at farm level all organisations may use a central (or regional database) in which all data are aggregated .

3 Quality controls

Quality controls mean that final results of an organisation, a company or an information system are checked against the expected results. In AI the final result is a progeny born from a specific female bred by a specific male but there are many in-between situations to assess degree of quality of AI data. It involves for example:

The AI collection centre: Is the semen contained in the straw, the semen of the bull that has been identified as the donor ?

The quality of cow identification and the effort to record it.

Work of the AI operator : correct use or not of straw to mate a female with a particular bull?

Birth registration : depending on cow owners and registration systems

Those quality controls are systematically used in most countries, in addition controls of the data that are carried out on a routine basis when technicians are recording information or when AI centres or central data bases are processing AI data.

Two classical means are used:

Counting of failures and implementation of indicators: how many data are rejected because there are not complete, not in coherence with the other relevant data or unlikely to occur?.

Blood types or DNA fingerprints. Most countries are implementing such controls, checking by random some groups of animals or specific animals such as calf born from embryo transfers. In some countries these results are published.

Remark: when blood types or DNA fingerprints are used to assess parentage when it's impossible by checking data – double AI for instance-, it is not considered as quality control but as specific tools. This is used in most of countries.

E. Integration and use of AI data in genetic information systems

To be used as zootechnical data, AI should come into a data base where other zootechnical data, as birth registration, bull cow herd identification, milk yield etc are available. Those data base are often run by other organisations than IA centres (milk recording, herd book, integrated systems between organisations, as it was described on the data flow) . Then genetic information systems, integrated or not with the general zootechnical systems are using those data part of the genetic evaluation process. The genetic evaluation process is usually organised at the national level by breed or for all breeds.

Before moving from a system to an other one, data are submitted to tests before being integrated in the data base. Coherence and likelihood tests are then carried out. Birth data are then often checked against AI data at this level .

AI data arrive in the data base at a variable frequency according to the processing scheme (one day-2 months).

Organisation in charge of recording AI data is responsible for corrections.

AI data are used in genetic systems in 3 ways in addition of the parentage assessment:

- They may be printed on the pedigree of females in calf
- They can be use to provide genetic evaluations for direct fertility of bulls
- They can be use to provide genetic evaluations for fertility of bulls

Most of the countries are implementing such use of AI data.