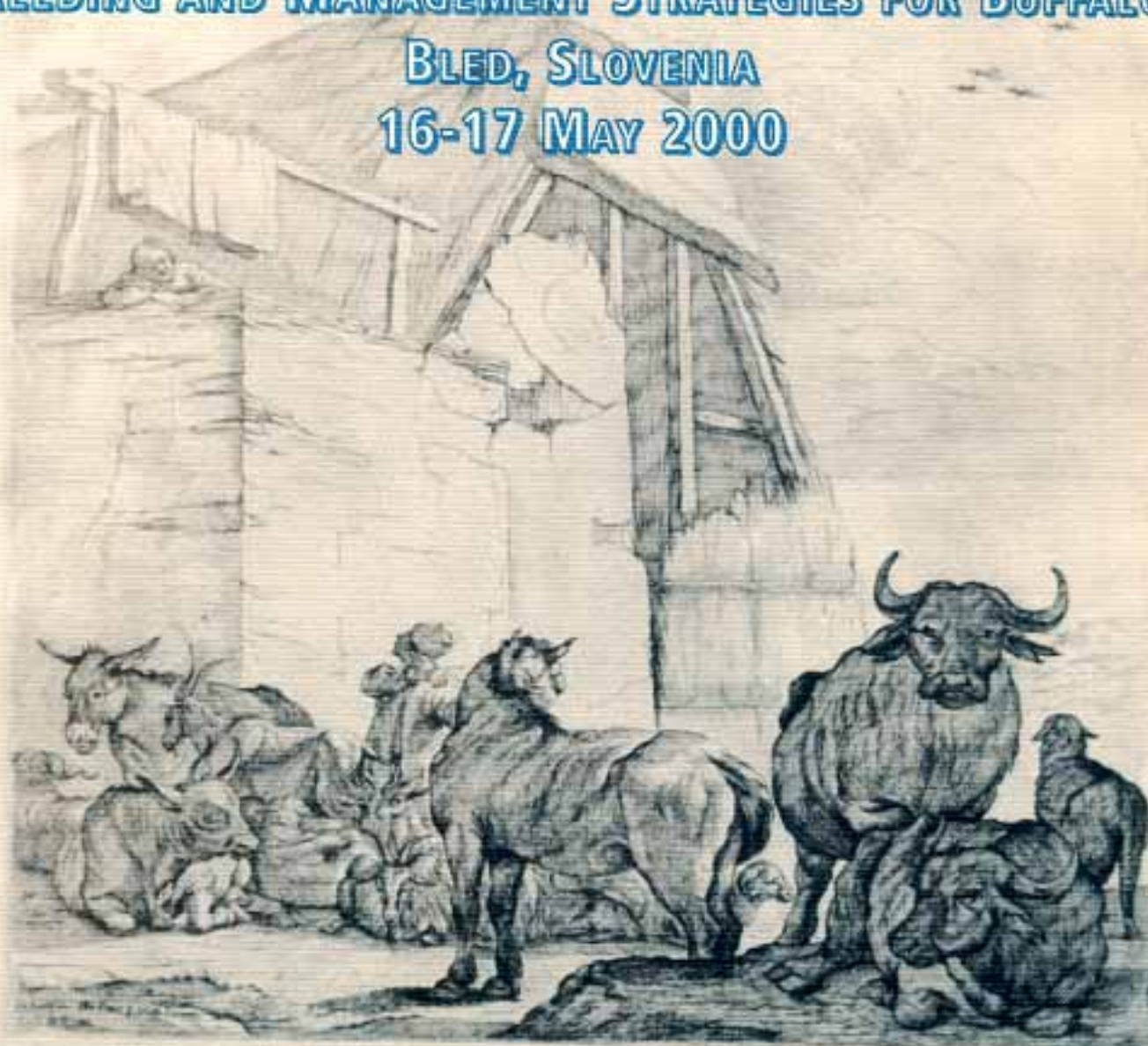


ICAR TECHNICAL SERIES No.4



WORKSHOP ON ANIMAL RECORDING FOR IMPROVED BREEDING AND MANAGEMENT STRATEGIES FOR BUFFALOES BLED, SLOVENIA 16-17 MAY 2000



*Questo caso di Arden V. Monje Samitico non solo è la struttura del corpo, ma di cui guardo
infine con un 12° più lungo della superiore, tutto di pinto e corte di Colli, ma ancora di lui
bisogna di alcuni caso, animali, Agony, Carony. L'anno 1659 per D. Stalioz e la Patria.
Abbedate.*

**EDITORS: B. MOIOLI, J. MÄKI-HOKKONEN, S. GALAL & M. ZIALIC
DECEMBER 2000**

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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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Animal Recording for Improved Breeding and Management Strategies for Buffaloes

**Proceedings of the Workshop held in
Bled, Slovenia, 16-17 May 2000**

Editors: B. Moioli, J. Mäki-Hokkonen, S. Galal & M. Zjalic

December 2000

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Preface

The International Committee for Animal Recording welcomed the participants of this Buffalo Workshop and acknowledged the Food and Agriculture Organization of the United Nations (FAO), in particular, Dr J. Maki-Hokkonen of the Animal Production and Health Division (AGA), for their support.

Animal recording, especially buffalo recording, is still unknown in many developing countries. Bearing in mind that animal recording represents the base of development of livestock production at national and farm levels, the aim of this Workshop was to promote buffalo milk recording systems by considering the already existing experiences of buffalo recording activities and by giving the opportunity to the invited experts to freely discuss the constraints, requirements and benefits of implementing standardised milk recording systems for buffalo.

Experts from fifteen countries prepared case studies describing the experience of animal recording in their country. These case studies served as a basis for the discussion held during the two day Workshop.

ICAR has 56 member organizations in 47 countries and around 400 participants from 56 countries attended the 32nd ICAR Session and INTERBULL Meeting.

In developing long-term strategies for promoting and standardising animal recording systems, ICAR follows the global strategy for the improvement of livestock production and quality.

I have been working on the Kerala Livestock Development Project in India, therefore, I am aware of the situation in developing countries. I believe that ICAR should provide guidelines for animal recording in low input production environments.

Buffalo is the largest livestock population in many developing countries and ICAR is concerned with the opportunity of establishing guidelines and recommendations for recording that can be universally applicable ensuring a satisfactory degree of uniformity and flexibility in the choice of the methods.

I am pleased that several non-member countries participated in this ICAR Session thus allowing the animal production experts to have the opportunity to verify ICAR purposes and actions. ICAR shall always be available to all countries to help, advise and to learn from them.



Dr Joseph Crettenand
President of ICAR

Foreword

J. Mäki-Hokkonen

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This is the first Workshop on buffalo recording that has been organized at an international level; the preparation has taken years of work and has required the inputs of animal production experts from many countries.

Several FAO offices have contributed to giving financial support to this Workshop: the Animal Production Division at FAO Headquarters, as well as the Regional Offices for Europe, the Near East and Asia, because FAO considers buffalo as a very important component in developing countries. Cattle numbers are stagnant, buffaloes are rising, both in number and production.

Objectives of the Workshop were to:

- promote buffalo recording in developing countries and to make possible comparison of animal productivity across countries;
- enforce international collaboration (network) for the development of buffalo production;
- increase awareness of the value of appropriate recording systems for the management of buffalo genetic resources;
- promote the use of records to assess the merit of animals, improve farm management systems and increase profitability of farming.

Cooperation between FAO and ICAR is active and continuous; in 1997 a Joint FAO-ICAR Workshop on “Animal Recording for Smallholders in Developing Countries” was held in Anand (India), ICAR’s efforts to expand its activities to developing countries were appreciated.

ICAR has established an *ad hoc* Task Force for developing countries and this Workshop shows the common platform that we have to promote milk recording in buffalo. We look forward to the ICAR guidelines and standards to be applied in FAO Member Nations.

By allowing everybody to discuss their positive and negative experiences in verifying constraints and benefits of establishing buffalo recording systems, FAO expects active participation in this Workshop. FAO hopes that the Workshop discussions will produce a set of guidelines and recommendations for the initiation and successful maintenance of recording systems for buffalo.



Part 1. Case studies



Buffalo recording systems in India

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Buffalo recording has been carried out under the programme referred to as “ Dairy Herd Improvement Programme Actions (DIPA)” in six districts in the State of Gujarat. The first DIPA programme was started in 1987 by the Mehsana District Cooperative Milk Producers’ Union in the Mehsana district for selective breeding of Mehsana buffaloes. Later, in 1989 the Kheda District Cooperative Milk Producers’ Union initiated a DIPA programme in the Kheda district for upgrading of local non-descript buffaloes with Murrah bulls. In 1992 another four cooperative unions namely the Sabarkantha District Cooperative Milk Producers’ Union, Baroda District Cooperative Union, Panchmahals District Cooperative Unions and Surat Cooperative Milk Producers’ Union in collaboration with the Sabarmati Ashram Gaushala (SAG) initiated a similar programme for upgrading the local non-descript buffaloes with Murrah buffalo bulls in their districts. These district milk cooperative institutions are farmer-owned organizations collecting, processing and marketing milk of their member producers. In 1998-99 these six cooperative unions collected and processed an average 3.2 million litres of milk a day. These organizations also provide technical input services like artificial insemination, cattle feed, fodder seeds and veterinary health care to their member producers. The DIPA programmes have been integrated with other services provided by the unions for enhancing milk production.

Dairying is an important source of income for the majority of farmers in these six districts. More than 70 percent of the households have cows and buffaloes. Livestock holdings are very small. Usually farmers have one to five animals.

Milk production takes place in many households each contributing a small quantity. Together, however, they produce a very large quantity of milk. Farmers live near to each other and keep buffaloes with them. As farmers live in conglomerations, they learn from each other and often follow common management practices. Livestock are managed by family labour

**Brief
description of
buffalo
recording
systems**

**Overall input
level of the
production
environment**

and fed largely on crop residues and supplemented with green fodder and concentrate. The farmers of the six districts could be put into low to medium input production systems.

Number of herds and buffaloes involved in recording

These districts have proportionally more buffaloes than cows. The ratio of buffaloes to cows is 7:3. The total production of buffalo milk to cow milk is 4:1. Some 218 villages have been involved in buffalo recording systems and about 3.5 percent of buffaloes have been covered under the DIPA programme (See Table 1 for district wise details).

Table 1. Number of buffaloes, milk production, AI coverage and DCSs under DIPA in six districts.

Particulars	Mehsana	Kheda	Sabar	Baroda	Panch	Surat
No. of villages	1 093	970	1 395	1 651	1 908	1 185
No. of households in '000	550	643	325	567	463	629
Breedable females in '000:						
• Buffaloes	362	413	261	202	231	140
• Cows	113	102	112	111	177	98
Predominant buffalo breed	Mehsana	ND	ND			ND
Other		Surati	Mehsana	ND	ND	Surati
<i>Milk production in '000 tons/year</i>						
• Buffalo	437	374	213	157	141	115
• Cow	125	137	81	65	61	56
Total DCSs	984	985	1 556	884	1 107	917
DCSs under AI	435	863	313	420	550	448
DCSs under DIPA	33	50	30	35	30	40
Percent recorded buffalo population	4	6	3	2.5	2	3

DCS: Dairy Cooperative Society; ND: Non-descript buffaloes

The recording systems were initiated with the purpose of genetic improvement of buffaloes through a well-planned, field-based progeny-testing programme. When the DIPA programme was initiated in any village, all breedable buffaloes were either eartagged altogether and registered under the programme or they were eartagged as and when they came for insemination. All events of artificial insemination (AI), pregnancy diagnosis (PD) and calving of dams were recorded. In the initial years of the programme, some dams after their calving were milk recorded once a month, morning and evening. This was done in order to know the production levels of foundation stock. However, all female calves born were included in the programme and closely followed from birth to their complete first lactation. Each female calf born under the programme was eartagged in the first 15 days and followed-up for growth by measuring length and heart girth every month. When the daughters born under the programme came into heat, they were inseminated and all events of artificial insemination, pregnancy diagnosis and calving were recorded. All daughters in first lactation were milk-recorded morning and evening once a month throughout their lactation. A sample of milk was collected at every recording in a sample bottle and tested for fat percentage at the dairy cooperative society in the village. Males born under the programme were not recorded for any characteristics except those young sires produced by nominated mating using top proven sires and top recorded daughters to be programme tested. The semen stations directly monitored the growth of young sires with the help of cooperative unions.

Categories of animals included in recording

The recording systems were initiated with the main purpose of achieving genetic improvement in milk and fat production in buffalo populations. However, as the programme was implemented, it was soon realised that unless farmers actively participated in the programme, the desired results would not be achieved and that the farmers would not participate in the programme unless they had some benefits. To ensure active participation of farmers, some specific programmes were initiated for improving management, nutrition and health care of their animals. Each female calf born under the programme was given five bags of cattle feed (about 350 kgs) in kind over a period of one and a half years. The service of de-worming of calves was given free-of-charge. Special attention was given to the health of all female calves. The information system was also suitably modified to provide information that is relevant to farmers for improving management of their animals. The main purposes of the programme today are: (i) to achieve higher genetic gain in buffalo population; (ii) to exploit genetic potential of buffaloes by improving management, nutrition and health of buffaloes; and (iii) to provide relevant information to farmers to help them in management of their buffaloes.

Purpose of recording systems

Type of identification

Buffaloes have been registered under the programme by applying a plastic eartag having an eight digit laser printed number. The last digit of each number is the check digit derived from the first seven digit serial number.

Traits measured and frequency

All events of artificial insemination, pregnancy diagnosis and calving are recorded on a routine basis. Recording of these events provides information on age at first calving, number of inseminations per conception, conception percentage on first service basis, service period, dry period and inter calving period.

All female calves born are followed up for growth by measuring heart girth and length on a monthly basis to provide estimates of body weights and growth rates.

All daughters after their calving are milk-recorded once a month morning and evening throughout their lactation. At every milk recording, quantity of milk produced in litres is recorded and a sample is taken to measure fat percentage in milk. Thus, quantities of milk and fat percentage are the two other traits recorded on a monthly basis. At the end of lactation, the date of drying off is recorded. This provides the information on lactation length, dry period and inter calving period.

Pedigree records have been maintained for all daughters born under the programme.

For each bull being test programmed, data on semen concentration, initial motility, post thaw motility and the number of doses produced are maintained ejaculation wise throughout the period they remain at the station. All bulls are examined for chromosomal abnormalities and tested for all known genetic diseases through DNA typing.

Data analysis

At each participating union, the required computing facilities have been created. Inseminators record events of artificial insemination, pregnancy diagnosis and calving. Milk recorders record milk production and fat tests. Supervisors record heart girth and lengths. They record all data in formats and send them to the computing centre of the Union. At the Union's computing centre, the data are entered and processed using the MIS-DIPA software. The software creates village, animal and bull files. These files are then transferred to the computing centre of the National Dairy Development Board (NDDB). At NDDB a central database has been created collecting data from all unions. NDDB estimate breeding values and pass that information back to the participating unions.

NDDDB has developed an in-house software for monitoring of all activities of the DIPA programme covering maintenance of bulls, production, processing and supply of semen doses, recording events of AI, PD and calving, measurement of heart girth and length and supply of cattle feed, recording of milk production and fat tests, etc. The data collected in different formats are processed at semen stations and union computing centres. Many performance reports are produced by the system. Since farmers have one or two animals, supplying information to farmers on performance of their animals is perhaps not very relevant, however, when information is produced for all animals within a village on key parameters then farmers obtain very useful information, as they then can compare their performance with other farmers and adopt good practices followed by better performing farmers within the village. Hence, the system produces performance reports village wise and within village for all animals together and not for each individual participating farmer. Whenever the supervisor visits his assigned village during his monthly visit, he carries with him the village wise performance report and the action list and discusses the reports with the inseminator and farmers and advises them on feeding and management of their animals. The system maintains animal wise information on age at calving, service period, number of inseminations per conception, lactation length, gestation period, dry period, inter-calving period, total milk yield, total milk days, 305 day milk yield, fat yield, etc. The estimation breeding values of bulls and all animals has been done centrally by NDDDB.

The participating dairy cooperative unions implement the DIPA programmes under the technical guidance of NDDDB. There is no involvement of the State or the Central Government in the programme. Each DIPA programme was initiated with the financial support of NDDDB. NDDDB met all the cost of implementation of the programme for the first five years. After five years of implementation of the programme, a separate corpus fund for each of the three DIPA programmes was created with the contribution from respective unions and the NDDDB. Each programme at present meets its costs from the interest earned from the long-term investment of the corpus fund and does not depend on any external agency for funding. If the cost of implementation of the programme in any particular year is more than the interest earned, the respective unions meet the additional costs. The fact that the Mehsana Union has been running the DIPA programme now for almost 12 years, the Kheda Union for ten years and the other four unions for six years, it indicates that the programme has been well accepted by the farmers and it will be run by farmers themselves for many years to come.

Farmers do not pay for recording. The cost of implementing the DIPA programme has been met through the interest earned from the investment of the corpus fund.

MIS-DIPA

**Government and
farmer
involvement**

Genetic improvement of buffaloes

Breeding Plan Design

The core breeding strategy adopted for the genetic improvement of buffaloes in all six districts is progeny testing of buffalo bulls involving farmers in selected villages. In the Mehsana districts a straight breeding strategy has been adopted to improve the Mehsana buffaloes of the district. In the Kheda district, a strategy of cross-breeding of local non-descript buffaloes with the Murrah breed has been implemented. Here the plan is to use Murrah bulls obtained from the Murrah breeding tract in Punjab and Haryana for two generations and then follow the strategy of straight-breeding in the resulting upgraded buffalo population as in the case of the Mehsana district. A similar breeding strategy has been planned in the third programme jointly implemented by the Sabarkantha, Baroda, Panchmahala and Surat milk unions and the SAG.

The core design adopted in all three programmes is depicted in figure I. A set of 10-20 bulls has been tested every year in each of three programmes. About 30-50 villages, each village having 200-300 breedable buffaloes, have been selected for the programme in each district. This means, about 6 000 to 10 000 breedable buffaloes in each district or 2 to 5 percent of the total breedable buffaloes of the districts have been selected for the programme. This population is referred to as recorded population of the DIPA programme. At present 40 percent of villages in the six districts have facilities for artificial insemination. This means about 0.65 million buffaloes constitute the target population that is intended to be improved through the DIPA programmes. The cooperative unions have planned to increase their AI service to about 75 percent of the villages in the next five years. The base population will therefore increase to some one million buffaloes in another five years.

Some 2 000 semen doses per bull are distributed in DIPA villages in a way that the number of daughters born to all bulls tested in each village across all DIPA villages would more or less be equal. To achieve this, a bull wise semen distribution schedule is prepared. Semen doses of all bulls tested are distributed every month. Every month each DIPA village receives semen doses from only one bull. Semen doses of different bulls are used in each DIPA village every month and it is ensured that within a year maximum, bulls tested are used in each DIPA village and across all DIPA villages. This ensures production of daughters of bulls tested in most villages and in all months. Apart from test doses, a minimum of 5 000 doses per bull are stored till progeny test results of bulls tested are available. The stored doses of some top bulls are later used for nominated service to produce the next generation of bulls.

Estimation of breeding values

Our experiences indicate that through the distribution of 2 000 semen doses in recorded population about 250 daughters per bull are produced. Many daughters born in the programme, however, are sold by the time they are

in first lactation. About 3 percent of daughters are lost through mortality. Only 50-80 completing first lactation records of daughters per bull finally becomes available for estimating breeding values of bulls.

Presently a sire model using the BLUP procedure is being used to estimate breeding values of bulls.

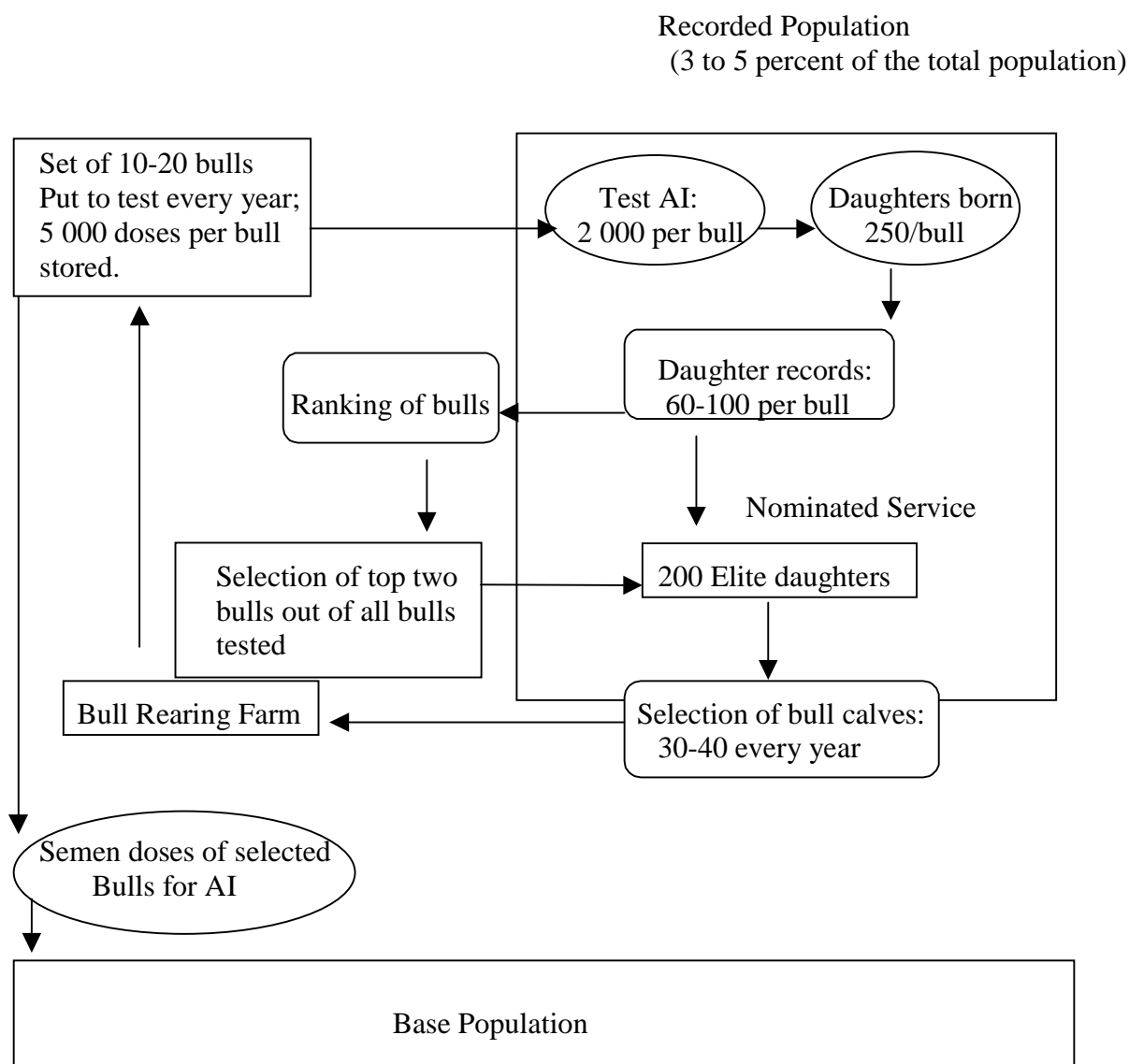


Figure 1. Breeding Plan of DIPA Programme.

Persons involved

NDDDB is responsible for estimating breeding values of bulls. To date, two officers have been involved in estimating breeding values at NDDDB. All unions now have internet facilities and they send their validated files to NDDDB through internet. A central database has been created at NDDDB. At union level, a team of three to four officers is involved in the implementation of the programme. A supervisor appointed by the participating union, one for ten DIPA villages, supervises implementation of all activities such as supervision of AI and PD, recording of all events of AI, PD, calving and milk recording, measurement of heart girth and length, distribution of cattle feed, supervision of milk recording, advising farmers on feeding and management using the feedback received from the MIS-DIPA system, etc. in their assigned villages. The village level inseminator carries out all insemination at village level. Either the inseminator or a separate person carries out monthly milk recording in every village. The milk recorder at every milking takes a sample for fat testing and estimates fat content of every sample at the dairy cooperative society in the village.

Dissemination of improved genetics

Improved genetics are passed on to the base population through the AI infrastructure created by each participating union. Every year each semen station uses the top two progeny tested bulls and about 200 top recorded daughters to produce the next generation of 20-40 young sires to be tested. About 50 percent of the young bulls after completing their test mating are retained for one to three more years at the semen station for producing semen doses to be used for the normal AI programme. Thus, the benefits of the programme have not only been passed on to the participating DIPA villages, but also to all villages that have AI facilities.

Case study on buffalo recording systems in Bulgaria

T. Peeva

Buffalo Research Institute, 9800 Shumen, Bulgaria

The recording system in Bulgaria goes back to 1953, when the cooperation of agriculture and buffalo farms for 100 to 500 dairy buffalo cows were established. The main reasons for establishing a well organized scheme were the implementation of machine milking and the establishment of an animal selection centre in every district.

- The approximate overall input level of the production environment.
Milk yield:
1st lactation – 1 650-1 750 kg, 7.5 fat percentage, 4.5 protein percentage;
2nd lactation – 1 800-2 000 kg;
3rd lactation – 1 920-2 350 kg;
body weight - 550-600 kg for adult female;
body weight - 700-800 kg for bulls.
- The approximate number of herds involved as a percentage of the total number of herds:
About 10 herds or 5-10 percent of the total number.
- The approximate number of recorded buffaloes:
250-300 buffalo cows.
- Animal categories involved in the recording process (all offspring, male or female offspring only, parents, etc.):
 - All dairy buffalo cows in the herds of the Buffalo Research Institute, Shoumen; cooperative farms; private farms with more than 20 buffalo cows and those cows which were selected for bull-mothers in the villages.
 - All male and female young animals in the Buffalo Research Institute and cooperative farms.
 - In private farms with one to two buffaloes, those of male calves which are selected for young bulls.

**Briefly
characterise
the buffalo
recording
system in your
country**

- Purposes of the system (on-farm management decisions, on-farm health decisions, on-farm breeding decisions, central breeding decisions, etc.).
 - on-farm management for nutrition according milk yield and daily gain for young animals;
 - to form the salary of the labourers;
 - on-farm breeding making breeding plans for the herd; for pedigree of the animals, for selection of female and male calves, offspring of bull-mothers;
 - central breeding decisions;
 - total number of recorded animals in the country;
 - average milk yield;
 - total number of culled buffalo cows and the reason for that;
 - total number of selected young bulls;
 - total number of the heifers for replacement;
 - total number of cows from AI;
 - adaptation of the list of bull-mothers.

- Type of animal identification employed.

All animals are identified at birth with an individual number on the right ear and their mother's number on the left one. There are also used tags with the same number on the right ear. A new registration system started last year according to the requirements of the European Union.

- Traits measured, frequency, etc.
 - milk yield, fat percentage, protein percentage - 4A;
 - body weight every month at the Buffalo Research Institute and cooperative farms;
 - body measurements every month for female animals and only the selected males.

- Other information collected (pedigree, feeding, health, etc.).
 - pedigree;
 - abortion;
 - premature born;
 - mortality;
 - twinning.

- Types of analyses of crude data.
 - on-farm
 - average milk yield;
 - number of dairy buffalo cows;
 - number of dry cows;
 - number of calvings;
 - date of insemination;
 - on the central location (see section on Purposes of the system).

- Is data computerised and stored and how?
An information database was established at the Buffalo Research Institute Shoumen and information from all over the country was stored. It was used for the estimation of genetic and phenotypic parameters of selection traits; correlation between traits, estimation of BV of the bulls and bull-mothers.
- Describe Government and farmer involvement.
About 60 percent of the total budget of the recording system is financed by the Government.
- Who pays the recording and has this changed over time and why?
The cost of milk recording, AI and training are covered by the farmers. The prices change according to inflation.
- Are there buffaloes that are officially recognised as being of higher genetic merit?
Yes.
- How many bulls? How many females? Are they evaluated every year? Or how often?
40-50 bull-mothers, 2 600 kg milk yield for 1st lactation (more 3SD; SD=320 kg).
About 80 000 deep frozen doses are kept in the station of AI from proven bulls with high genetic merit (BLUP).
- How is their genetic merit established?
 - on pedigree, up to grandparents, half-sibs, minimum 40-50 observations;
 - on pedigree, regression dam-daughters;
 - regression, daughter-herd mate;
 - contemporary comparison, BLUP, minimum ten daughters, selection index, including milk yield, fat percentage, protein and AFC.
- The most important moment for the genetic improvement of the buffalo population is making a breeding programme including parameters of selection traits; number of lactations; number of inseminations for one conception; percentage fertilisation; genetic standard deviation; proportion of selected buffalo cows; intensity of selection; generation interval; heritability of traits; number of dams for one young bull; size of the progeny group; etc.

Each breeding programme is worked out according to the conditions of the country. A team of researchers, programmers and mathematicians are needed for the development of the programme. The infrastructure

Do you have a genetic improvement programme for buffalo?

of the recording system is in second place of importance for the genetic improvement of the population. In countries where the size of the herds is comparatively big (from 20 to 150) the milk recording is easy to realise. It is however, very difficult in countries where 80 percent of the buffaloes are raised on small farms (1-2 buffalo cows). This requires a large number of staff and high transport costs. The size of the population under AI is in third place of importance at present.

- How is the genetic improvement distributed all over the country?
 - AI;
 - sale of animals, a couple of farmers buy a bull with their own money.

Case study on animal recording for improved breeding and management strategies on Buffalo. Country: Italy

M. Fioretti, A. Rosati & R. Aleandri

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The buffalo recording system for dairy buffalo in Italy is organized as dairy cattle recording (AIA). The Italian Animal Breeders' Association organizes, collects and manages information from recorded animals. Provincial Animal Breeders' Associations (APA), associated to AIA and located in each Italian province, are authorised to record productive and reproductive data from animals in the province, send recorded data to AIA and receive elaborated information from AIA to give to breeders.

**Approximate
overall input
level of the
production
environment**

In Italy 283 herds are registered for official data recording (AIA, 1999). The number of recorded buffalo cows is 20 882 with an average milk production of 2 092 kg, a fat percentage of 8.37 and protein percentage of 4.8 (AIA, 1999).

**Approximate
number of
recorded herds**

The recording process for milk production involves lactating cows, while the recording process for pedigree involves all animals (male and female offspring, parents).

**Animal
categories
involved**

The purposes of the recording system are to facilitate farm breeding management by furnishing to breeders information on productive and reproductive performances of animals; to organize a central breeding decision by overall information on productive performances from all recorded animals and their genetic merit; and to allow genetic improvement for milk production and quality.

Purposes

Animal identification is carried out by giving all offspring an identification code. The code is common for the recording authority (AIA and APA), Ministry of Public Health (which is in charge of controlling animal health and related diseases) and the National Buffalo Breeders' Association (ANASB) who are responsible for the Buffalo Herd Book.

**Type of
identification
employed**

Traits measured, frequencies, etc.

The recorded traits are milk yield and milk quality; samples are taken to estimate fat and protein percentages with standard instruments and procedures in official laboratories. Milk recording is performed following the International Committee for Animal Recording (ICAR) guidelines. Type B records are not performed. Each animal production is recorded with the A4 method; the average interval between subsequent controls is four weeks. Information involving lactation (drying date, recording dates, last recording date, number of recordings, number of milking per day) are also recorded.

Other information collected

Other information collected during the recording process are pedigree and other reproductive information as calving date, insemination date, calving difficulty, sex of calf, etc.

Data are collected by APA's technicians: production data are sent to AIA which is in charge of collecting production information from the country and analysing it, while pedigree information was sent to ANASB for use in the Herd Book.

Data computerisation and storing

No data analyses are performed on raw data while on farms; data are analysed when received by AIA. Data are loaded in APA computers using specific software and sent by e-mail to AIA, which stores the information in the central national database for buffalo milk production. Data are then analysed and some calculations are performed to create, for each recorded animal, information about lactation length, total milk yield, fat and protein production, 270-d production. Data analyses are performed following ICAR guidelines. Information related to each specific farm is printed with data on all lactating animals for that farm. The forms are then returned to the provincial office, which distribute them to each farm.

Government and farmer involvement

Government and farmer are both involved in financial support of the recording activity. Actually, the Government pays for about 80 percent or total costs while farmers pay the rest.

The proportion of the Government's and farmer's financial support has changed over time, the actual trend is to increase the farmer's contribution. The acceptance of the scheme is positive.

Genetic improvement programme for buffalo

Italy has an on-going genetic improvement programme for buffaloes. The genetic programme is under the responsibility of ANASB; the Technical Office of AIA, on ANASB's request, produces genetic indexes. Progeny testing is carried out on buffalo sires. Genetic estimates for milk, fat and protein yield and fat and protein percentages for several buffaloes are available. Genetic merit information is available for nine males and

1 960 females. The first genetic evaluation was carried out by AIA in 1997 and the next one should be completed by 2000. An amount of 39 437 females and 377 males were genetically evaluated. A BLUP Animal Model establishes the genetic merit. Mozzarella yield is considered as a selection index.

ANASB is responsible for genetic improvement of the buffalo species. Genetic indexes are provided by AIA. The best males and females are identified and their male offspring are selected by pedigree index and checked for morphological and health problems before being included in a progeny test trial. A designed scheme is applied to identify best dams and sires based on genetic indexes and accuracy. Genetic improvement is distributed all over the country by using tested bull semen and by making high genetic merit animals available to herd book farms.



Animal recording for improved breeding and management strategies of Buffalo in Pakistan

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Buffalo is the main dairy animal in the country. About 22 million buffaloes supply 17 million tons of milk, which is about 70 percent of the milk produced in the country. Buffaloes are part of the traditional small mixed farming system integrated with crop production. Herd size is very small; 85 percent of buffaloes are raised in herds of size one to five. Recording of buffaloes is mainly done in the seven institutional herds and on a few military farms. Apart from these, buffaloes at farmer level are recorded under the progeny testing programme which has been carried out since 1980. Dairying is not quite commercial so the level of inputs is very low. Generally, animals are fed on crop residues with some additional forage/fodder grown for the purpose. Hay and silage making does not exist, except to some extent for institutional herds. Concentrates are fed to those animals that are kept for the sale of milk. The Government facilitates vaccination against contagious diseases at nominal prices. About 5-10 percent of breedable females are artificially inseminated while the rest are mated naturally with bulls of a good type. Credit facilities have also been made available to the farmers for the purchase of milch animals but on a limited scale.

The number is estimated between four and five million, with more than 85 percent of buffaloes in one to five animals. The recorded herds are less than one percent of the population.

- Recorded buffaloes.
There are about 1 000 breedable Nili-Ravi buffaloes in seven institutional herds in Punjab along with about 5 000 recorded buffaloes with 27 field recording centres.
- Animal categories involved in the recording process.

Buffalo recording system in Pakistan

Input level of production environment

Number of herds

In institutional herds, all animals are recorded but at farmer level, only registered females are recorded.

- Purposes of the system.
The field recording is mainly done for progeny testing bulls. The registered farmers are provided help in disease coverage and AI.
- Type of animal identification employed.
Animals are generally eartagged. Hot or cold branding is also practised on institutional herds.
- Traits measured.
Milk yield is the most commonly measured trait along with age, lactation length, calving interval, etc. Frequency of milk recording is once a week at institutional and once a month at field level.
- Other information collected.
Information on pedigree, breeding records and vaccination is also maintained.
- Types of analyses of crude data.
 - on-farm: calculations for lactation milk yields, calving intervals, etc. are done at farm level.
 - at the central location: contemporary comparison has been the bull comparison method at the central location. Recently, the animal model has also been employed to calculate breeding values of bulls and buffaloes.
- Data computerisation and storage.
Data collected at farmer level is merged with the data collected on institutional herds and stored in computers for statistical analysis.
- Government and farmer involvement.
 - financial support: field recording is Government sponsored. Participating farmers are facilitated in terms of free AI and help in disease coverage.
 - levels of acceptance of the scheme: the venture is very limited at field level but quite acceptable to the farmers.
- Payment for recording.
Farmers do not pay for recording but are facilitated to participate in the recording activity. This has not changed with time.

Genetic improvement programme for buffalo

- Buffaloes are officially recognised as being of higher genetic merit. Simultaneous buffalo and bull evaluation is being carried out and elite buffaloes which are one standard deviation above the recording centre's mean for milk yield (elite buffaloes), are used for the production of future bull calves.
- Bulls and females evaluated every year.
The initial progeny testing programme was intended to evaluate around 20 bulls every year with 200 pregnancies per bull. Evaluation has not been as frequent as was intended at the inception of the programme. The last bull evaluation was done in January 1999 where 78 bulls from the first six batches (4, 4, 16, 19, 11 and 24 bulls, respectively) were

evaluated. The average number of daughters per bull was about 20. Bulls from the eleventh batch were progeny tested in 1999. Daughters of bulls for batches seven to ten are at different stages of growth and production. Evaluation of buffaloes is being carried out simultaneously with that of bulls. When bull evaluation was not regular, buffaloes were still evaluated using a production index such as milk yield per day of age at second calving.

- System of establishing genetic merit.
The breeding value for the first lactation milk yield was the criteria to evaluate bulls and buffaloes. Recently, such breeding values have been calculated under an animal model. A minimum number of five daughters was the criteria to include a bull in the evaluation.
- Organization responsible for genetic evaluation.
Basically, the programme is being run by the Livestock Production Research Institute, Bahadurnagar (Okara). The researchers at the University of Agriculture, Faisalabad, collaborate in these efforts especially in data entry/editing/analysis. About 40 personnel are involved including 27 recorders/inseminators and other office/laboratory staff.
- Genetic improvement distribution.
Semen of progeny tested bulls is distributed in the country through AI and is priced slightly higher than the non-proven sires.
- Genetic improvement programme established in the past.
The current progeny testing programme, established in 1980, still continues with ups and downs. Attempts in the past include buffalo recording efforts in the central and southern districts of Punjab (10-Districts project) which ended with the termination of the project before its scheduled time. A cooperative organization (Idara-e-Kisan) which collects milk from its member farmers for processing and packing, plans extensive buffalo recording in central Punjab. The Directorate of Breed Improvement, Government of Punjab, is also planning a more vast recording system for execution. The weak link between teaching, research and extension is also being strengthened.



A case study of Buffalo recording and breeding management in Nepal

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Introduction

Buffaloes are the multi-purpose and most valued livestock species in the smallholder mixed farming system of Nepal. The country has a population of 3.3 million heads of buffalo, The seventh largest number in the world, contributing in excess of 8 percent of the country's overall gross domestic products and they are distributed throughout the country (Table 1) except in the high Trans-Himalayan mountain zone. However, the use of the buffalo recording system is at the introductory stage, while the breeding systems for their genetic improvement are still traditional except for some efforts of cross-breeding with Indian Murrah breed. The current buffalo recording systems are characterised by the activities that are carried out in a few institutional herds as a part of routine farm operation and for research purposes and in a few farmer herds mainly for comparison of the performance of the indigenous stocks and Murrah cross-breds.

Table 1. Buffalo population distribution across the physiographic agro-ecological zones and development regions in Nepal (figures in '000).

Agro-eco zones	Development Regions					Total
	Far-western	Mid-western	Western	Central	Eastern	
Mountains	89.3	31.8	0.2	96.5	86.6	304.5
Hills	184.3	265.7	756.1	410.0	302.9	1 918.7
Terai	136.0	192.8	193.2	311.2	306.0	1 139.2
Total	3 409.6	490.3	949.6	817.5	695.4	3 362.4

Source: CBS (1997).

Characteristics of current buffalo recording

Production environment and input levels

The buffaloes are reared mostly by the smallholder farmers at a very low input level in the mixed farming systems in Nepal and their production systems vary greatly across the agro-eco zones. In the Southern Terai belt, inner Terai and mid-hill river valleys, buffaloes are mainly kept under complete stall feeding during seasons of crop cultivation and are occasionally tethered or allowed to graze freely in the crop fields whenever there are no standing crops. Stall feeding is more permanent for the higher yielding animals. In the Himalayan foot hills, grazing of buffalo in the village pasture, forests and recently harvested crop fields is more frequently seen, although there is a tendency to keep the milking buffalo within the fence of the homesteads. In the high hills and mountains, they are even reared under migratory herds which are taken up to the high altitude of alpine pasture, sometimes beyond 3 500 m, crossing the tree line in the southern face of the Himalayas. Thus, environments, in which buffalo are reared, are diverse depending upon their physiographic locations.

Buffaloes in Nepal are well known for their ability to thrive on low quality forage, as they utilise crop residues, straws of rice, millet, wheat and legumes across all agro-eco zones, but are also fed on green forage. It is usually the milking buffalo which is offered high quality green fodder and some supplemental grains on a regular basis.

In Terai, inner Terai and the lower hills, buffalo are usually given permanent housing either separate from or attached to the house of the owner farmers. As the altitude increases towards North, the buffalo housing tends to be increasingly temporary and poorly built, exposing the animals to an increasingly cold climate.

Herds involved

There are three institutional herds currently being milk recorded in the country. The Department of Livestock Services (DLS) owned a Livestock Development Farm at Lampatan, Pokhara maintains a breeding herd of about 100 Murrah cows and five to ten Murrah bulls which provide young bulls for dispersal under the cross-breeding programme throughout the country. The Agricultural Research Station, Lumle of the Nepal Agricultural Research Council (NARC) has recently acquired 30 hill buffalo cows and their followers and the Regional Agricultural Research Station, Tarahara of NARC ikeeps about 20 Terai buffalo cows and their followers. Both these latter herds are used primarily to assess the performance of indigenous stocks on station production environments.

In addition, the Agricultural Research Station, Lumle has been carrying out the milk recording activity in farmer buffaloes in its research command area of western hills for the past ten years.

The number of milking buffaloes in Nepal was estimated at 821 000 in 1995-96 (Karki, 1997). In proportion to the size of the population, the number of recorded buffaloes (Table 2) is negligible.

Approximate number of recorded buffaloes

In the institutional herds, records of milking buffaloes with their offspring, mates and pedigree are maintained. However, due to the lack of the past breeding history of farmer herds, only individual animals owning records are available from the farmer herd recording. Some of the farmers' animals may not even be recorded for the full term of lactation due to selling of the animal to another farmer during lactation.

Animal categories involved in the recording process

The purpose of recording in institutional herds is mainly for farm management decisions which include revenue accounting, feeding, health care and farm level breeding decisions and research purposes. In farmer herds, recording is solely for research purposes to assess and compare the level of performance between Murrah cross-breds and indigenous buffaloes.

Purpose of the recording system

Table 2. Number of milking buffaloes being recorded across the areas/locations in the past and present.

Locations (type of herds)	No. of buffalo recorded before 1998	No. of buffalo recorded after 1998
1. Lampatan Livestock Development Farm (on-station)	60-85 per year	90
2. Lumle Agricultural Research Station (on-station)	20 per year	30
3. Lumle Agricultural Research Station (farmer herds)	500 in three rounds of recording	~400
4. Tarahara Agricultural Research Station (on-station)	20 per year	20
5. Pakhribas Agricultural Research Station (farmer herds)	200 (only in 1989)	discontinued

Source: Annual Reports of the respective stations.

All animals both in institutional as well as farmer herds being recorded are usually identified using standard dairy cattle eartags. However, the animal identification is entirely an arrangement at the station level or the research project level and the identification numbers are not registered centrally.

Type of animal identification employed

Traits measured and frequency

The traits measured in milking buffaloes being recorded at the Lumle Station include yield from two time milkings on the test day, milk fat content on a mid lactation day, lactation length and their reproductive traits such as age at calving, calving interval, days to first service, etc. at a frequency as shown in table 3.

Table 3. The frequency of recording in on-station and on-farm milking buffaloes in the western hills research command area of Lumle Station.

Traits measured	Frequency in farmer herds (on-farm)	Frequency in institutional herds (on-station)
Milk yield and other lactational information	now monthly (fortnightly in the past)	daily
Milk fat content	once at 5-6 months of lactation	occasionally
Reproductive traits	retrospectively	regular on-farm records

Other information collected

Institutional herds have records of pedigree, feeding rations, health care and immunisation, mating or artificial insemination and day to day farm activities relating to the recorded animal. However, farmers' animals generally lack this information particularly of the past, although some feeding and health care information is collected during the lactation recording.

Types of analyses of crude data

The data available at Lumle Station from buffalo recording are processed for statistical analyses using software such as Harvey's Least-Squares, SAS, SPSS, Genstat, for reporting the results of breed blood level comparison of lactation and reproductive traits (Rasali *et al*, 1997b, 1998) and lactation curves (Rasali and Harding, 1998). On the Lampatan Farm and the Tarahara Station, recorded data are analysed in spreadsheets for reporting the simple statistics on the records of performance in their Annual Reports.

Data computerisation and storage

The data, recorded both on-station and on-farm by Lumle Station are entered into Lotus or Excel spreadsheets as well as farm registers and stored. On the Lampatan Farm, buffalo herd records including records of performance are computerised using University of Minnesota "Dairy Champ" software. At the Tarahara Station, the records are normally kept in farm registers.

Government and farmer involvement

Recording of all animals in the institutional herds is the responsibility of the respective government farms and research stations where the buffalo are kept. The Animal Breeding and Artificial Insemination Section and

Planning Division of the Department of Livestock Services may occasionally require reports of the progress made by the Departmental farms on farm operations and production figures.

Only in cases where recording in farmer herds is carried out are farmers involved. Such a case is organized by Lumle Agricultural Research Station, as a part of its buffalo research programme. Four agro-ecological research (AER) sites and eight other outreach research (OR) sites of Lumle Station are designated where buffalo recording work is currently on-going in farmer herds. Buffalo farmers in each site are given clear orientation on the recording and their involvement in the activity. There is provision of some incentives to the farmers in terms of support services such as parasitic drenching and vaccination of animals being recorded for ensuring full cooperation from the farmers in the activity.

All expenses (such as staff costs and recurrent expenses for recording and incentives) for buffalo recording currently undertaken at Lumle Station come out of a research project funded by the Hill Agricultural Research Project (HARP) and NARC budgets. In other farms and stations, such expenses are part of their regular budgets.

Recording expenses and incentives

Cross-breeding of indigenous buffalo with Indian breeds such as Murrah has been the national policy for their genetic improvement programme. Both natural service and artificial insemination are the methods used for implementing the programme. In the past, unrestricted grading up of indigenous buffalo with Murrah buffalo blood has been the policy throughout the country. Limiting the Murrah blood to 62.5 percent in the cross-breds has been considered recently, particularly for the central hill areas (ABAIS, 1997), while low adaptability of the upgrades in the higher altitudes could be a major reason for low adoption of cross-bred buffalo in the western hills reported in a study (Floyd *et al*, 1999).

Genetic improvement programme for buffalo

Some kind of selection and culling is taking place in the Murrah herd maintained at Lampatan Farm, but is mainly on the basis of records of performance of the mother cows. However, systematic genetic analysis or progeny testing is non-existent in the buffalo herds in Nepal.

While no systematic programme is yet in place for the genetic improvement through selection in buffaloes, official recognition of any buffalo to select for breeding based on its higher genetic merit does not exist. However, every year the District Livestock Services Office in 75 districts organize a competition in which a number of milking buffaloes are selected for milk recording for a limited period (usually two to three months during lactation). Based on the milk records obtained from the competition, individual cows are selected for awarding the prize to the owner farmers.

Are there buffaloes that are officially recognised as being of higher genetic merit?

The replacement stock in the institutional herds are selected on the basis of physical appearance of the individual animals and the performance records of their sire and dams.

**How many bulls?
How many
females?**

The system of evaluating bulls and female buffaloes for future breeding based on their genetic merit is not common. Replacement breeding animals are chosen based on the direct observations of the individual animals and/or records of performance of the dams.

**How is the genetic
merit established?**

Due to the lack of a programme for evaluation of bulls and formulation of selection criteria, the direct observations of the individual buffaloes and records of performance of their dams are the main criteria considered to assess a buffalo for replacement stock in both institutional and farmer herds. Large body capacity, attractive appearance, grey coat colour, long limbs, non-aggressiveness with good temperament, high yielding dams, good health and brightness are considered some of the important characteristics of desirable bulls (Rasali *et al.*, 1997a).

**The organization
responsible for
the genetic
evaluation and the
number of staff
involved in each
phase of the
programme**

The national organizations responsible for the genetic evaluation of buffalo herds are the Animal Breeding Division of the Nepal Agricultural Research Council (NARC) and the Animal Breeding and Artificial Insemination Section of the Department of Livestock Services (DLS) both under the Ministry of Agriculture, but a national programme coordinating these two institutions for genetic evaluation of buffalo herds for a systematic buffalo breeding programme is lacking. However, the experience of cross-breeding efforts and their impact and a number of research results on both cross-bred and indigenous buffaloes accumulating in recent years are leading to the realisation for the need of a national buffalo genetic evaluation programme based on a buffalo recording system.

**How is the genetic
improvement
distributed all
over the country?**

The district offices for livestock services are responsible for providing breeding services for the genetic improvement of buffalo. Most of the district offices have a number of Murrah bulls targeted for distribution to the farmers every year. In 43 accessible districts, AI service using frozen Murrah bull semen is also provided. Breeding bulls of indigenous breeds are raised by the farmers themselves and kept for future breeding.

AI stations

Presently, there is a total of 132 AI service centres in 43 accessible districts (ABAIS, 1997). The central Animal Breeding and Artificial Insemination Section located in Kathmandu valley and its three regional Semen Banks at Lahan, Bhairahawa and Nepalganj, supply frozen semen and liquid

nitrogen to these AI centres at monthly intervals. These AI service centres charge a nominal registration fee for AI service provided to the farmers' buffalo.

Natural service is the main method of buffalo breeding in Nepal. For cross-breeding, district level offices for livestock services procure a number of Murrah bulls either from the Government farms (such as Lampatan Farm), or from farmers or sometimes even from India and distribute them on a cost basis with a transportation subsidy, to the farmers through its network of service centres (9 to 25) throughout the district. Bulls of indigenous breeds are acquired by the needy farmers themselves from the local sources, as these are not provided from government agencies. The bull user farmers in a village community join together into a Village Buffalo Development Committee to raise money for the price of the bull, acquire the bull and maintain it as a "Bull Station" for the breeding service. One or two relatively more resourceful farmers in some villages may also maintain their own private bulls. The fee for the bull service is charged, usually once a season, to the owner of the buffalo bred. However, buffalo bulls of both exotic and indigenous breeds are in inadequate supply against the demand among the buffalo farmers due to constraints such as early disposal of locally born male calves to save their dams' milk for human consumption (Rasali and Crow, 1999) and the high cost of maintaining a breeding buffalo bull as compared to the return from the bull service charge (Rasali *et al.*, 1997a).

Natural breeding stations

Government farms sell buffalo bulls produced in the farms to the farmers for use in breeding, usually through District Livestock Services Offices or on their recommendation. Sales or exchange of bulls or breeding females among the buffalo farmers are also very common.

Sale of breeding animals (who buys them?)

The programme for cross-breeding of indigenous buffaloes with the Murrah breed has continually been a part of the livestock development programme in Nepal for more than four decades. The establishment of a Murrah herd in Lampatan Farm with the assistance of a German aided project in the 1970s, a buffalo improvement programme of various integrated rural development projects in the 1980s and a Livestock Development project (in three phases from 1980 to date) are the major investments which have introduced Murrah blood into the indigenous buffalo population and also created Murrah cross-bred pocket areas in various parts of the country. The cross-breeding programme is still continuing. However, there is a lack of programme for improving the indigenous breeds and a definite programme to stabilise cross-bred buffalo population.

It is very important to specify if some kind of genetic improvement programme was established in the past

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Buffalo recording and breeding practices in Egypt. A case study

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The overall input level of the production environment is low. Egyptian buffaloes are mostly kept under a low input production system. About 97.5 percent of these buffaloes are maintained in small herds (one to five breedable females). The small herds suffer from malnutrition, poor housing, lack of proper veterinary services and also from impaired management practices. The supporting services of AI, milk recording, genetic evaluation and milk marketing systems are not available. Larger commercial herds enjoy relatively better input levels according to the herd size. Flying herds located in peri-urban areas have good nutritional and managerial situations due to their high milk revenues.

The cattle Information System/Egypt of the Cairo University (CISE) records about 290 small (one to five heads), 27 medium (6-20 heads) and six large herds (21-100 heads). CISE is a member of ICAR and follows ICAR guidelines in milk recording. However, due to the lack of finance, only the milk volume is recorded. Fat, protein and SCC analyses are not available. The Animal Production Research Institute (APRI) records four State herds belonging to APRI. These herd sizes are 50, 80, 100 and 100 heads. Also, APRI records five buffalo herds of 50, 70, 75, 80 and 500 breedable females. However, there is no data processing yielding herd averages or computer archives to calculate the 305 d or total milk of the whole lactation of individual buffalo cows. The Breeders' Service Unit of APRI provided free complete milk analysis and SCC for the enrolled herds.

Percentage wise, the small recorded herds represent only 0.03 percent of the total small buffalo herds in Egypt; herds of 6-20 heads represent about one percent and those of 21-100 heads represent 3.5 percent with only one very large herd (500 heads) recorded by APRI.

CISE record about 1 200 heads, APRI record about 2 000 including their research farms. Other research institutions record an extra 1 000 heads. The approximate total number of recorded buffaloes is 4 200 heads.

Buffalo Recording in Egypt

The overall input level of the production environment

Number of herds involved

Number of recorded buffaloes

Animal categories involved

At present, CISE covers only milk production and reproductive performance of breedable females. Research institutions keep complete detailed records on all categories of animals maintained on their farms.

Purpose of the system

Most of the farms use hand kept records for controlling farm activity and help decision- making in farm management. Research institutions keep and use records mainly for research purposes. The Cattle Information System/Egypt (CISE) produces technical monthly reports and sends them to the farmers. The reports include: herd summary, individual information on each recorded animal and lists for farmer's attention. In the meantime, CISE recently started to perform the genetic evaluation but to date no sire or cow directory has been published due to the lack of strong and continuous links between milk recording and AI organizations. No herd book (or herd registry) is processed in Egypt.

Type of animal identification

Plastic and metal eartags are the most common identification methods. Liquid nitrogen branding was not successful for buffalo and disappeared after a short time. Some farms use ear tattooing. No national identification programme with original animal ID is applied.

Traits measured and frequency

CISE records milk yield and reproductive performance once a month (ICAR - A4). Also, APRI records milk yield, full milk constitution and SCC once a month. Research institutions use detailed records for daily, monthly and lifetime milk production, health records, feeding records and reproduction records. These records are used to monitor the day to day farm activities.

Other information collected

CISE has archive files to store information on pedigree and health information for individual animals and animal movement (new births, sales, purchases, etc.).

Analysis of data

CISE is the only institution in Egypt performing data analysis centrally. The centre owns a well equipped network for data entry, processing and reporting. CISE produces monthly reports including: 1) herd summary; 2) individual information on each individual buffalo cow; and 3) an attention list to help the farm management process. Recently, CISE started to calculate breeding values of bulls and cows. Most of the other institutions do not process the original data. Few others, however, have farm management programmes working on PCs to analyse the data to help on-farm decision-making.

CISE has a computer network capable of processing data on 50 thousand cows/year. CISE also store the data in archive files to be used in genetic evaluation and ultimately to build a dairy database for research and planning. APRI also has an equipped computer hall, however, no actual data processing or storage is carried out due to lack of required computer software. No other institutions or buffalo farms are known to computerise and store data in Egypt.

Data computerisation and storage

The Government does not provide direct financial support for milk recording. However, the Ministry of Agriculture and Land Reclamation (MALR) has helped CISE to upgrade its computer facility to act as the National Central Data Processing Laboratory. This help was done through TCP/FAO assistance to plan a “Dairy Herd Improvement System in Egypt”. The recording running cost of CISE is covered by a few large cattle farms in addition to financial support from the Central Fund for Developing Animal Wealth in Reclaimed Lands (CFDAW). APRI as one of the MALR institutions receives better financial support from the EU project “Food Sector Development Program (FSDP)”. The farmers’ involvement in financial support is very limited and thus their acceptance of the scheme. However, better enrolment could be achieved for large commercial farms by providing recording incentives, especially, SCC and by determining fat and protein contents of milk.

Government and farmer involvement

Few large cattle farms pay the cost of recording for CISE which also benefits from the financial support of development agencies especially the World Food Programme (WFP) through CFDAW. APRI provides free SCC and milk analyses services depending completely on financial support from the EU (FSDP). The lack of financial support from the Government is due to the lack of awareness to the importance of a recording scheme for developing the dairy industry.

Payment for recording

No genetic improvement programmes are practiced in Egypt due mainly to the lack of links between recording, genetic evaluation and AI institutions.

Genetic improvement programmes

No official identification for buffalo of higher genetic merit exists at present. CISE recently started to perform genetic evaluations on a small scale for some large enrolled herds. It was agreed that the Animal Production Sector of MALR will stamp (authenticate) these evaluations and initiate a national herd book.

Identifying high genetic merit

Frequency of evaluation

CISE is planning to perform a genetic evaluation of recorded animals once a year. The interval could be shortened to six months in the future.

Systems of genetic evaluation

CISE uses the DFREML Animal Model procedure to perform genetic evaluation. All available information is used in the animal model to calculate the animal's transmitting ability. APRI uses the dam's yield to calculate the bull's breeding value, however, the final decision on its use in insemination depends on conformation, physical status and semen quality.

Genetic evaluation organization

No specific organization is assigned to be responsible for the genetic evaluation. CISE is conducting the genetic evaluation at present. The document of the "Dairy Herd Improvement System in Egypt (DHIS)" prepared for MALR by FAO and CISE experts, nominated CISE as the National Central Data Processing Laboratory and APRI, to conduct genetic evaluation since it also largely contributes to AI.

Dissemination of genetic improvement

No genetic evaluation is practiced. Two main institutions that produce bulls and frozen semen for insemination are APRI and the General Authority for Veterinary services (GAVS). APRI selects young buffalo bulls provisionally according to dam milk yield. However, the final decision is based on the bull's physical fitness and its semen quality. The General Authority for Veterinary Services selects buffalo bulls from the market according to their body conformation, physical fitness and semen quality.

APRI provides farmers with frozen semen from buffaloes on a cost recovery basis. Also, APRI provides farms and breeders with insemination bulls tested for health and semen quality. GAVS has AI and natural mating bulls in veterinary clinics spread in some villages of the country.

Past experience in genetic improvement programmes

In 1974 Cairo University started a research project financed by the Egyptian Academy of Science and Technology to establish a progeny testing programme to produce buffalo proven bulls. The project collected about 500 buffaloes representing a buffalo gene pool in Egypt. The project tested ten bulls to produce two proven bulls annually. MALR was expected, as planned before starting the project, to take over responsibility and expand the project to establish a national scale progeny testing scheme with strong links between recording, genetic evaluation and AI organizations. The programme was terminated in 1982 mainly because of financial difficulties and lack of coordination between the university and the Ministry (MALR).

A case study on Buffalo recording and breeding in Iran

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There are 519 000 buffaloes in Iran. The buffalo farming system in Iran is based on smallholders (99 percent); most of the herds have an average of five animals; a few herds have a number of buffaloes between 20 and 50; some of them have 300 buffaloes. Smallholders manage their animals according to the opportunities offered by the environment: pasture, stubble, shrubs and grass. Most of them get their feeding by grazing along water sources: streams, rivers, ponds, lakes, plus the following by-products: citrus peels and pulp, sugar-cane wastage, etc.

In Khuzestan, buffaloes are raised outdoors throughout the year; in the north-west they are housed in autumn-winter.

Buffalo farming in Iran can be considered of a good level because a) owned or rented properties are of a large size; and b) susceptible land for buffalo farming is also large. Buffalo farming has been a traditional activity for many decades.

A project for buffalo development and improvement was started in 1993 and is still being carried out in Iran. At present there is a project on "expansion of buffalo" from the traditional 8-16 provinces, after having considered environment as well as employment opportunities.

The traditional eight provinces are the following: Khuzestan, West-Azerbaijan, Lorestan, Gilan, East-Azerbaijan, Ardebil, Mazandaran and Golestan.

The provinces in which the project aims to increase the number of buffaloes are the following: four provinces with a number of buffalo heads at present ranging from 500 to 1 000 buffaloes: Elam, Fars, Kermanshah and Zanjan.

**Briefly
characterise
the buffalo
recording
system in Iran**

**Overall input
level of the
production
environment**

Four provinces with a number of buffalo heads at present ranging from 100 to 500 buffaloes: Hamadan, Kurdistan, Sistan and Boshher Baluchistan. Transportation of surplus buffaloes from traditional to new provinces has already started.

In conclusion, looking at feeding, health conditions, breeding management, marketing of products and also standard of living, buffalo farmers can be included in the intermediate social class. Following the present policy of extension of buffalo and development of recording systems, an increase in the production level to be achieved in the short-term, is expected.

Approximate number of herds involved in the milk recording activity

At present there are 800 recorded buffalo herds (0.8 percent of total herds); 150 more herds are foreseen in the project for buffalo expansion. The approximate number of milk recorded buffaloes is 14 000 (plus 1 000 buffaloes in the project for expansion).

Animal categories involved in the recording process

According to the type of record:

- milk production and reproduction parameters in all females;
- weight and conformation for meat production in experimental farms for adults and offspring of both sexes;
- reproduction parameters in males after puberty;
- genealogy records;
- culling records, sales, vaccines, diseases, etc.

Purpose of recording systems

At present, on farm management (health and breeding decisions, vaccines, etc). At national level: identification and recognition of different types of buffaloes, Kuhzestani, Azari and Mazandarani for milk production potential, beef potential and reproductive potential; description of all management systems, including feeding, animal marketing, marketing of products, breeding decisions (replacement and culling, choice of breeding bull).

Once an adequate number of records is available at national level (10 000-12 000 lactation records) we plan to process them at central level through the calculation of least square means, breeding values, heritabilities, repeatability and variance components.

Our strategies are based on the following three sections:

- determining the response to the selection on economic traits and decision on the level of achievement of genetic progress in the three populations.
- If the response to selection is positive, we will go further.

- If the response to selection is not positive, we will try to use interbreeding between different types and exotic breeds from suitable zones and cross-breeding through a severe control process. The word “interbreeding” is used because the three types of buffaloes at present reared in Iran (Khuzestani, Mazandarani and Azari) are considered different breeds on the basis of their phenotype. By exotic breeds, the river type buffaloes reared outside of Iran is intended.

The final purpose will be to distribute the best genotypes to overall population of each type, with the help of artificial insemination. Based on our breeding strategy, the distributed top animals will be one to five percent of the overall population.

Eartagging is the most frequently used; if lost it is repeatedly implanted with a new eartag or tattoo; neck collar, used for calves until 6-9 months; belt or rope with numbered label; in tied systems, single stalls are numbered.

Type of animal identification employed

The phenotype of each animal is described in the record: horn shape, white spots, other. Each animal is identified by name of the owner, dam and sire, village of birth. In experimental farms, in some cases, the animal number is applied with the cryogenic method.

Milk and fat are recorded monthly in fields (villages).

They are recorded daily or weekly in experimental stations, if necessary. Protein are only sometimes analysed (mostly in stations). There are three buffalo experimental stations in Iran:

1. Jabal Station at Urmia (West-Azerbaijan) with 300 buffaloes.
2. Safiababad Station at Dezfoul (Khuzestan) with 200 buffaloes.
3. Mollasani Station at Ahwaz (Khuzestan) with 100 buffaloes.

Frequency of recording

No recording at village level, except in some cases, guessed weights and measurements with an iron yard. In experimental stations, buffaloes are weighed at birth, 1-2-3-4-5-6-7-8-9-12-18 months and maturity.

Growth and beef conformation

Occurrence of first estrus, age at puberty, time of first insemination, estrus occurrence, date of natural mating or of insemination are usually recorded. In villages date of dry off, date of calving, calving type and conditions, in some cases conception date are recorded. In stations the previous parameters are recorded in addition to the length of post-partum anestrus, length of estrus in daytime, days open, number of services per conception and reproduction efficiency.

Reproductive traits

Health records

In villages: for occurrence of special diseases.
In stations: for resistance to diseases (duration of treatments); type of treatments; resistance to treatment or vaccine.

Body conformation scoring

Not at village level. In stations, females are scored at birth, before first mating, heifers, at first lactation, at third and over lactation. Males are scored: at birth, 12 months; puberty; maturity and when necessary.

Other information: feeding

- Feeding in villages:
 - the number of days grazing;
 - type of administered by-product;
 - feed supplements by hand: barley, wheat bran, straw, oil cakes.
- In stations:
 - standard feeding with simulation on labels; control of ingested residual feedstuff; growth rate; and calculation of feed efficiency index.

Pedigree

- In villages: because of natural mating, only the mother of the progeny was recorded (the sire, only when available); at present, both mother and sire are recorded. Other records include herd, birth date, body colour and spots.
- In stations: both dam and sire are recorded.

Analysis of crude data

On-farm, the technician is given the list of the animals of the herd with indication of the last event (calving, dry-off). List of lactating buffaloes with indication of last event: number of day tests; milk/fat yield up to the present day test; total milk/fat yield of previous lactations; average lactation duration, average number of days dry, average days open, both individual and for the herd.

The list is prepared by the deputy of livestock affairs of each province; the Animal Breeding Centre of Karaj provides the scheme and the forms to be conformed to the national system. The Animal Breeding Centre of Karaj is also the supervisor of the performance recording in every province. All forms are computer printed. Overall advice on culling and selection for economical purposes.

The advice is given through several printed forms:

- a. average productive and reproductive parameters for each herd (the signature of the directorship of the Animal Breeding Centre is given on each farm);
- b. monthly report for each herd: list of buffaloes with last event, productive and reproductive parameters of each buffalo;

- c. reports at different dates (yearly, quarterly, every six months) with a list of best/worst buffaloes of each herd, village, town, city and province.
- Regional reports: a description of breed characteristics on the following parameters: frequency of culling, drying, dystocia, calving conditions; average values of milk productivity and reproduction patterns; indication of peculiarities. Regional reports are prepared according to the needs of each province.
 - At the central location: beyond the already mentioned records, weights and morphology are registered. The co-efficient of inbreeding is also calculated. Calculation of composite herds and standards lists on animal and herd. The co-efficient of inbreeding is calculated only for herds where pedigree registration of the sire is effective (Khuzestan province and part of Lorestan Ardebil and West-Azerbaijan).
 - Calculation of genetic parameters: the breeding values are calculated for sires and dams from half-sib records.
 - Genetic trend and genetic progress for all traits in the total population.
 - Determination of animal breeding strategy for total population.

All recorded data are sent to the Animal Breeding Centre of Karaj and stored in a data bank. The Animal Breeding Centre has a self-designed programme for:

- transfer of data;
 - data filtering: e.g. date of dry-off must fall after insemination, etc. (errors are indicated by special code); and
 - final reports on productive/reproductive traits.
-
- Data input, print and data calling;
 - reception of data from provinces;
 - final control file for printing and merging with analysis files;
 - report printing (preparation of all forms for on-field data recording);
 - option menu: all types of data selection, preparation of data files, preparation of descriptive statistics, pedigree updating, breeding values updating, correction);
 - guide board.

The project is designed to support smallholders through extension, education, increasing of recording, increasing of awareness and improvement of structures and management. Therefore, support is given by giving the farmers animal feed concentrates, barley, wheat and provision of semen, as well as help for disinfecting and rebuilding of the structures. Also long-term loans are provided at low interest.

Computerisation of data

Description of Animal Breeding Centre computer system

Government and farmer involvement

Level of acceptance

Accepted in areas where buffalo production is economically very important (first agricultural activity, or second, after crops).

Accepted at different levels according to the education level of the farmers. Production efficiency of the area: farmers of higher milk/meat productivity tend to more easily accept the protectional project scheme.

Payment of recording

- Official recording system, based on Government staff (agents and technicians). All executive functions are performed by Government technicians. This staff is appointed by the Deputy of Livestock, Ministry of Agriculture and covers by the whole country. They are trained by the experts of the Animal Breeding Centre.
- Non-governmental system
 - records are performed by the buffalo owner (but also mostly promoted by farmers in each region).
 - Local cooperatives of farmers.

In both cases, executive operations are supervised by Government staff under the control of the Animal Breeding Centre, which has several branches in all provinces. The system is submitted to modification, according to special requests from particular areas (e.g. number of available animals in the most remote areas).

At present, all costs of the recording activity are borne by the Government, but it is planned to shift to the private sector in order to extend recording, provide occupation opportunities and decrease Government costs.

Genetic improvement programme

We have an on-going programme which is now at the end of the stage of recognition. At this stage we are able to determine the production potential of the population for any economic trait and therefore, we know the best dams and sires to be introduced into the whole population.

Buffaloes officially recognised as being of higher genetic merit

In Kuhzestan we have recognised over 100 female buffaloes with a test day milk yield of 27 kg (not including the suckled milk, therefore, if the intake is included, yield gets higher). Last year in Kuhzestan 20 bulls and 100 females were officially evaluated in the herds participating in the recording project (ONBS). Evaluation is performed every year. Year after year accuracy of evaluation increases. According to our forecast, the number of buffaloes to be evaluated in the near future, including other provinces, will be increased four to five times (i.e. 80-100 bulls and 400-500 females).

System of establishing genetic merit

We have four different methods:

- a. Test day method: in this method, only the three test days of each lactation with the highest milk yield are taken into account.
- b. Least Square Mean of the test day peak in total lactation. Selection is based on corrected test peaks (selection goal is the peak of milking).

- c. Lactation milk yield in the first 200 days lactation, based on average production and persistency (selection on milk yield).
- d. Least square means of lactation milk yield in the first 200 days (selection on corrected milk yield).

For prediction of breeding values, at least one complete lactation with three to seven tests is requested.

Important: to each method, an adjustment co-efficient is applied accounting for environmental conditions. The following factors are considered for the calculation of the adjustment co-efficient: feeding level, health status and level of education of the farmer. Then a final index is given to every buffalo with a list ranking the buffaloes. Separate lists are printed according to the employed evaluation method (three day test of 200 days lactation).

All rearing conditions and possible environments are studied finally with type evaluation on the main productive traits. Selected buffaloes are examined and finally confirmed and their male offspring are transferred to the stations.

- a. LSM: at first, test of co-variance for pre-correction of correlated traits is carried out. Secondly, a model for adjusting non-genetic factors (age of buffalo, number of lactation, herd/year/season effect) as well as dam and sire effects (genetic) is applied. Finally, values of estimates of LSM of each trait are used. At this stage, we still need more information about pedigree of animals, mainly the sires and the relationships between dams, therefore, the method is applied only for calculating the correction factors and not for genetic evaluation.
- b. Genetic evaluation method.
 1. Test of normality by K-S test (Kolmogurov-Smirnov) or median, mode, mean, skewness and kurtosis are calculated for assessing normality of distribution of dependent variables.
 2. Determination of rate of significance for any independent traits and combination of the traits (with single or multiple regression, by ENTER or STEPWISE methods).
 3. Study of combinations between variables: interaction effect, polynomial effect, for example: season*year or season*herd or herd*year; weight:sire or weight:breed, linearity or non-linearity.
 4. Input of significant traits into final true model with the above-mentioned fixed and random effects.
 5. Solution of the designed model by Harvey 90, PEST, SAS, JAA, REML, DFREML.

Determination of LSM and BV for each animal and adjustment co-efficients for fixed effects. In the areas where sires are not registered, evaluation is made by the regression dam-daughter.

Description of evaluation methods

Minimum number of requested records:

- for method of lactation milk yield in first 200 days: two lactations;
- for method of three test day peak: 20 tests;
- for analysis of population, minimum 4 000 completed lactations and minimum 28 000 recorded day tests.

Responsible organization for the genetic evaluation

- a. Animal Breeding Centre, Karaj with following staff: one technical deputy; one responsible for buffalo section, one staff member for data input in computer.
- b. Deputy of Livestock Affairs in Tehran (Central office): buffalo section, one person.
- c. Provincial executive branches: one responsible person for the project in each province, plus local staff according to the number of herds and buffaloes (recording operations, registration, etc.)

Distribution of genetic improvement all over the country

- a. With AI since the beginning of the buffalo project, 35 top bulls have been used in AI centres and 7 200 buffaloes were inseminated with fresh semen. At present, 1 800 buffaloes are inseminated every year with frozen semen. There are six AI centres in Iran.
 1. Jabal (West-Azerbaijan, 30 km from Urmia, on the road to Mahabad). It has 15 breeding bulls producing 8 000 frozen semen doses per year.
 2. Bardieh (Khuzestan, at Susangerd). It has three bulls that produce fresh semen to cover the needs of 100 herds (1 000 buffaloes) in the villages around Susangerd.
 3. Daravizeh (Khuzestan, at Ahwaz) will soon be operational (the breeding bulls are at present being selected). It will keep 30 breeding bulls every year. It will cover most of the semen needs of Khuzestan with fresh semen. The top selected bulls of Khuzestan will be transported to Jabal for producing frozen semen.
 4. There are three more stations for supportive research purposes: Sardrood, Safiabad, Mollasani.
- b. In natural breeding stations for the herds located near the stations.
- c. With natural mating within the herds and sale of best animals made by stations and large herds (over 50 buffaloes) that have been recognised by the Animal Breeding Centre.

No genetic improvement programme has ever been established in the past.

Case study of Azerbaijan on animal recording. Breeding and management strategies of Buffalo

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The situation of buffalo reproduction in Azerbaijan was first examined in 1926 under the leadership of E.E. Kaluga. Later, this work was chaired by A.A. Agabayli (1950-1967) who learned exterior, constitution, productivity and fodder problems in the maintenance and caring of young buffalo. Buffaloes have always been the most valuable genefund of Azerbaijan.

Introduction

Table 1. Trends and recent changes in the total number of buffaloes in Azerbaijan.

Category	Unit	Year				
		1995	1996	1997	1998	1999
Total number of buffaloes	'000 heads	291.9	298.0	302.0	293.3	288.8
Mother buffaloes	'000 heads	122.9	128.0	134.9	135.5	132.3

Table 2. The past situation in the total number of buffaloes and different production in Azerbaijan.

Category	Unit	Year		
		1982	1987	1988
Total number of buffaloes	'000 heads	105.9	128.4	126.8
Mother buffaloes	'000 heads	25.8	29.0	29.5
Milk production	'000 tons	26.9	27.5	28.4
Average milk production per lactation	Kg	1 086	1 024	1 019
Calf crop	%	69	68	68

Table 3. The approximate overall input level of the production environment in Azerbaijan in 1999.

Category	Four State Pedigree farms				Total
	Dashuz	Devechi	Zardob	Khanlar	
Total number of buffaloes, heads	279	315	57	273	1 224
Mother buffaloes, heads	87	92	82	84	345
Milk production, tons	27.1	19.0	16.7	55.5	118.3
Milk production per lactation, kg	525	152	141	542	312
Calf crop, %	66	37	26	62	45
Pedigree sale, heads	15	10	10	25	60
Average body weight, kg	290	290	290	290	290
Meat production, tons	9.5	19	34.8	6.9	88

Table 4. Approximate number of recorded buffaloes.

Category	Year	
	1999	2000
Number of recorded buffaloes (on State pedigree farms), herds	474	563

Before reforms there were 45 pedigree farms of buffaloes in the kolkhozes and sovkhoses of Azerbaijan. There were about 50 State Pedigree Amalgamations in all the regions of Azerbaijan. These State Pedigree Amalgamations carried out selection-pedigree work, annual evaluation, individual registration, milk production and fat registration, etc. They recorded all categories of animals maintained in all sovkhoses and kolkhozes. After reforms, the activity of these State Pedigree Amalgamations stopped. Now only four State Pedigree Farms remain. The approximate total number of recorded buffaloes of these State Pedigree Farms is about 400-563 heads.

Animal categories involved in the recording process:

- All offspring

Purposes of the system

- On-farm health decisions (free vaccination) and farm breeding decisions.
- Before reforms all kolkhozes and sovkhoses and all of the State Pedigree Amalgamations used records for farm breeding decisions. The Republic State Pedigree Amalgamation (RSPA) used records for central breeding decisions. The veterinary laboratories in parallel used records for health decisions (for carrying out of free vaccination). The Azerbaijan Research Institution of Animals used records mainly for research purposes.

- The RSPA produced technical monthly, quarterly and annual records and sent them to the farms (kolkhozes and sovkhoses). The reports included: the total number of buffaloes on the farms, milk and meat production, offspring, average daily increase, average fat percentage, buffaloes slaughtered, average milk yield, sold breeding buffaloes and feeding, reproduction etc.
- Now most private farms use hand kept records for controlling farm activity and help decision-making in farm management. The State Pedigree farms and the RSPA used records for farm breeding decisions and the veterinary laboratories used records for health decisions. The Azerbaijan Research Institution of Animals used records mainly for research purposes.

- eartags;
- ear painting;
- tweezers.

Type of animal identification employed

For estimation of exterior of cattle, measurements were taken from measures implements:

- measured stick;
- measured compasses;
- measured ribbon.

Traits measured, frequency, etc.

The most widespread measures are the following:

- By measured stick
 - small of the back height;
 - depth of breast;
 - breadth of breast behind the shoulder-blades;
 - slanting length of body, etc.
- By measured ribbon
 - slanting length of body (such as by measured stick);
 - straight length of body;
 - circumference of breast;
 - circumference of heel.
- By measured compasses
 - slanting length of croup;
 - slanting length of back;
 - measures of head (length of head, length of frontal (forehead), etc.

Every year in October, the estimation of the exterior of cattle are taken by State Pedigree farms.

RSPA had produced and sent forms to the farms:

- Form 1- pedigree sire card;
- Form 2 - cows registration card;
- Form 3 - dry and breeding of animals;

- Form 4 - calves registration;
- Form 5 - analysis of milk productions;
- Form 6- milk control list, etc.

The number of forms has now been reduced. Before reforms we only had the social sector. Privatisation has already come to an end. Only a small part of animals remained State property (on Pedigree Farms) but the others were privatised as a whole. The farming structure in Azerbaijan consists of 36 000 peasant (farmer) housekeepings. About 96 percent of buffaloes are maintained in small herds (1-10 heads). The supporting services of AI, milk recording, genetic evaluation and milk marketing systems are not available. When breeding bulls are selected, we give more emphasis to milk and meat production. In the past and at present, an aggregate index has built up from both milk and meat productivity.

Other information collected

- pedigree;
- milk production;
- health;
- development;
- weight;
- constitution, etc.

Information on health includes fertility, calving interval, age at first calving, mortality, strength.

Types of analyses of crude data: on-State pedigree farms.

Data are not computerised and stored

We have registers on paper (see section above on Traits, measures, frequencies, etc.). There is an exchange of buffaloes between the four State Pedigree Farms in order to avoid inbreeding.

Government and farmer involvement

- State pedigree farms: very little financial support is given from the Government.
- On farmer farms: at their own expense.

Who pays the recording

Before reforms (until 1990), Government paid for the recording, now it is the State Pedigree farms who pay.

Genetic improvement programme

During the period of the Soviet Union reign we had genetic improvement programmes (plans) for buffalo. These genetic improvement programmes were prepared every ten years. Now the State Pedigree farms do not have the financial possibilities to continue these programmes. The programmes have not stopped now, but it is very difficult to continue their operation.

All females and all bulls are evaluated every year.

At present, on State Pedigree farms about 300-500 heads of buffaloes are evaluated and the level of carrying out evaluation is very low.

In the past each of the 60 buffalo farms evaluated 2 127 bulls and 34 042 mother buffaloes every year. Then and now State Pedigree farms evaluated their own animals jointly with the zooengineer-selectioner from RSPA and from the Ministry of Agriculture and determine class, age and other indexes. On the basis of these indexes the following are decided:

- to cull less productive or less desirable bulls from a herd; or
- to remain; or
- to sell.

On the four State Pedigree farms about 18-20 bulls (15-20 mother buffaloes per bull) are evaluated every year and these bulls are used for natural insemination. However, there are no AI stations of buffaloes and no official progeny test of bulls. In the past on all 60 buffalo farms and now on all of the four State Pedigree farms, the selection of bulls was made through the data collected on buffaloes.

See section on Traits, Measurements, etc. and previous section. It is not possible to answer this question in more detail as a lot of documents have been destroyed.

The State Pedigree farms are responsible for the genetic evaluation. See a former section. Twenty persons (on small farms) and 40-50 persons (on large farms) were at each Pedigree Amalgamate. They were in subordination of the RSPA and of the Ministry of Agriculture, but they served farms by agreement (contract).

There are no natural breeding stations in Azerbaijan, therefore private farmers keep their own bulls or borrow the bull from other farmers or from pedigree farms (if the farm is near the pedigree farms). The State Pedigree farms serve about 15-20 mother buffaloes for each bull every year and the female buffalo is left with the bull for mating.

The farms buy them. The price of a young proven bull is about US\$500 (proven young female is about US\$300-350). The price of an old proven bull is about US\$1 000 (proven young female US\$700).

The price of a young non-proven bull from another farmer is about US\$250 (female is about US\$150-170) and old non-proven is about US\$500-600 (female is about US\$300-350).

How is the genetic merit established?

Organization responsible for the genetic evaluation

Genetic improvement distributed throughout the country

It is very important to specify if some kind of genetic improvement programme was established in the past but finished for some reason, describe the reasons.

- The Azerbaijan Scientific-Research Institute of Pedigree Cattle Breeding for fifty years (1951-1999) developed and applied methods, technologies and systems of feeding, breeding, reproduction and AI of buffaloes. Numerous large buffalo farms were established with pedigree buffalo stock. The Republic of Azerbaijan within the USSR was the only republic where buffalo breeding was a traditional and widely developed branch of agriculture: 85 percent of buffaloes bred in the USSR came from Azerbaijan, while 15 percent of buffaloes in other republics also originated from Azerbaijan. All scientific projects in the former USSR concerning buffalo breeding were coordinated from Azerbaijan.
- Thus, it was not pure chance that in the beginning of the 1960s, we (Dr. E. Bashirov) had to undertake a very important mission to select and to send from India (Bombay) to Bulgaria by sea transport (former USSR ship) buffaloes, Murrah strain. Later Bulgarian scientists created a world-known, highly-productive buffalo strain “Bulgarian Murrah”. Representatives of this strain are used in Azerbaijan as a pedigree stock for cross-breeding with Caucasian buffalo.
- We keep separate pedigree records for Murrah cross-bred buffaloes and for pure-bred Caucasian (now called Azerbaijanian) buffaloes. Only about ten old mother buffaloes are Murrah in Dashuz. Almost all of the total 132 295 mother buffaloes of Azerbaijan are Azerbaijanian (Caucasian) buffaloes. All bulls and mother buffaloes kept at Dashuz, Devechi, Zardob and Khanlar are also Azerbaijanian buffaloes.
- It may be that there are some Murrah cross-bred on private farms, but no information is available.
- Unfortunately, during the transition period, after the USSR collapse, we are facing many difficulties and problems in buffalo breeding. Privatisation of cattle growing farms was quite successful, in particular that of buffalo-growing farms (the former sovkhoses and kolkhozes). However, in general the establishment of new buffalo-rearing farms is behind the times due to the shortage of finances and a few buffalo farms are facing numerous difficulties, related mainly to financing. The selection and improvement of buffaloes are now carried out spontaneously.
- To date, there has been no coordination-consulting centre in the Republic on buffalo-breeding. This also adversely affects research activity and practical work in this area. The number of buffaloes in many regions of the Republic is reducing. Valuable pedigree cattle are used for slaughter.

However, in the Republic of Azerbaijan we have all the necessary conditions for the organization of a specialised coordination-consulting centre on buffalo-breeding with FAO on buffalo-breeding, with experimental farms (both usual and pedigree cattle rearing farms), land sites, feed stock and personnel.

Buffalo breeding in Bangladesh

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Bangladesh has about 100 000 adult female buffaloes that are being used for dairy purposes. These buffalo are found in the Bramhaputra-Jamuna flood plain of central Bangladesh, the Ganges-Meghna tidal flood plain of southern Bangladesh and institutional herds. A brief description of the buffalo is presented in table 1.

From table 1 it appears that Bangladesh has milk/dairy buffaloes of swamp, cross-bred and river type. The occurrence of cross-bred dairy buffaloes indicates that the genetic improvement programme was run and is still being run to date. A brief description of past and present breeding programmes (with success and constraints) is given below.

DLS possessed a small herd of dairy buffaloes of Murah and Nili-Ravi breeds along with dairy cattle in Dhaka city. Between 1969-1970, a number of Murrah and Nili-Ravi bulls from that farm were distributed to the Ganges-Meghna tidal flood plain for cross-breeding with the indigenous dairy buffaloes. There was neither a selection programme nor extra manpower involved in that programme. After 1970 with the expansion of Dhaka city, the farm was closed and buffaloes were shifted to the central cattle breeding farm at Savar. The buffaloes were kept idle there until 1985. In 1985 the buffaloes (25 heads) of that farm were transferred to the newly built Buffalo Breeding Farm (BBF) at Bagherat, 400 km south-west of Dhaka.

BBF was designed to maintain about 500 buffaloes of different age groups and to produce superior bulls. In addition to the 25 buffaloes from Savar, it had 40 Nili-Ravi females and ten bulls imported from Pakistan and 60 indigenous river buffaloes at the start. In 1995 there were 350 buffaloes. At present, there are 196 buffaloes consisting of 31 milking females, 40 dry, 46 heifers, 19 bulls, 12 growing males, nine bullocks and 39 calves.

**Buffalo
breeding
activities of
the Directorate
of Livestock
Services (DLS)**

This farm has so far sold 190 bulls of Nili-Ravi x indigenous river type to the farmers of the Gange-Meghna tidal flood plain for cross-breeding of dairy buffaloes. These bulls are officially considered as being of higher genetic merit. The females are evaluated on their own performance and bulls are selected on dam yield and on their own performances, by the DLS staff.

Table 1. Description of dairy buffaloes in Bangladesh.

Parameter	Bramhaputra-Jumana flood plain	Ganges-Meghna tidal flood plain	Institutional herds
Population size	5 000	95 000	211
Herd size (no. animals/herd)	2 - 10	300 - 800	Herd no. 1 (15 animals) Herd no. 2 (196 animals)
Type/breed	Surati, unknown river type	Nili-Ravi x swamp, swamp, Murrah x swamp	Nerd no. 1 (Murrah x unknown river type) Herd no. 2 (Nili-Ravi, Nili-Ravi x unknown river type)
Animal identification method	Name of animal	Name of animal, ear notching	Eartag
Mating system	Natural	Natural	Natural
Management system	<ul style="list-style-type: none"> • Semi-intensive • Individually raised all year • Individually raised 6 months, collectively raised 6 months 	<ul style="list-style-type: none"> • Extensive • Collectively raised throughout the year 	<ul style="list-style-type: none"> • Intensive • Semi-intensive
Record keeping done by:	<ul style="list-style-type: none"> • Milk man • Only adult females • Milk yield • On-farm management • None • 200* 	<ul style="list-style-type: none"> • Milk man • Only adult females • Milk yield • On-farm management • None • 800* 	<ul style="list-style-type: none"> • Farm staff • All types of animals • All economic traits • Herd no. 1: on-farm management • Herd no. 2: central breeding decision • BAU staff • 200

* A record keeping scheme on economic traits of all categories of buffaloes for future selection and genetic improvement purpose on-farm in two main regions has been started by ABG department of BAU in collaboration with BLRI and BARC since 1998. Data are being computerised for subsequent scientific analysis.

There is no geneticist involved in the evaluation and improvement programme of BBF. The managers, nutritionists and veterinarians are sent to the farm following contracts and are changed frequently. Milk recorders and other subordinate staff have been there for a long time.

The constraints associated with BBF are lack of skilled personnel, AI facilities and failure to follow the performances of cross-bred progeny at field level.

BAU is located at Mymensing, 120 km north-west of Dhaka. The BAU dairy farm has 15 dairy buffaloes of cross-bred type and one bull of indigenous river type. The BAU Centre had Murrah and Nili-Ravi in the past. The Genetics and Animal Breeding Department (ABG) has already completed the characterisation of dairy buffaloes in Bangladesh. ABG has in collaboration with the Bangladesh Livestock Research Institute (BLRI) and the Bangladesh Agricultural Research Council (BARC) developed a field recording system for an on-farm breeding programme and has also recently produced about 100 pedigree calves. The ABG has failed to transfer AI technology to BBF and has also failed to maintain breeding bulls badly needed for the Bramhaputra Jumuna flood plain.

**Buffalo
breeding
activities at
the
Bangladesh
Agricultural
University
(BAU)**



Development of record keeping systems for genetic improvement of village milk buffaloes in Bangladesh: a case study

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Accurate record keeping is essential for effectiveness of selective breeding for genetic improvement of buffaloes. To ensure that the record keeping is accurate, a total of seven systems was introduced in different locations from 1888 to 1999. System VII proved to be the most effective for accurate record keeping of buffaloes.

Bangladesh possesses a substantial number of buffaloes (820 000). Milk yield of indigenous buffaloes is higher than that of indigenous cattle, but lower compared to exotic improved buffalo breeds. Therefore, measures should be taken to improve the productivity of indigenous buffaloes through appropriate husbandry practices as well as genetic improvement of the animals. FAO has recommended the Open Nucleus Breeding Scheme (ONBS) with or without MOET, for animal genetic improvement through selective breeding in developing countries.

The ONBS may make it possible to select bulls accurately since bulls will be selected from the nucleus unit. However, problems associated with field recording of the productive traits of village herds have to be solved. The following are the problems to face when implementing an effective record keeping system for productivity traits of village herds of buffalo in Bangladesh, as in many other developing countries:

1. Lack of infra-structure and trained personnel
2. Illiteracy of the farmer
3. Existence of middle-men
4. Poverty and socio-economic problems.

Summary

Introduction

To solve these problems, a number of attempts were made in different locations where dairy buffaloes are raised in the country (Table 1). The aim was to find out an easy and economical method for accurate record keeping systems for practicing selective breeding in the villages.

Table 1. Description of the experiment: farmer's degree of literacy, animal management system and record keeping system in the experiment sites.

Site	Degree of literacy	Animal management system	Prevailing record keeping system
Trisal	All farmers are illiterate	Buffaloes were raised by individual farmers under a semi-intensive system	No record keeping existing
Bogra	All farmers are illiterate	Buffaloes were raised by individual farmers under a semi-intensive system for 6 months, then collectively in <i>bathan</i> under an extensive system for 6 months	Milk yield is not recorded but the amount sold is recorded by milkman
Noakhali	All farmers are literate	Buffaloes were raised collectively by cowboys in <i>bathan</i> under an extensive system throughout the year	Milk yield is recorded through a graduated bamboo stick following traditional counting method, by both the cowboys and the milkmen

A number of systems were practiced in Tirsal during 1988-1992. The best one was identified and was applied to the other sites during 1998-1999 to test whether the system was equally effective throughout Bangladesh. The details of the systems are presented in table 2.

Table 2. Different tentative recording systems experimented in different sites.

Period	Location	Distance From campus	System no.	Description of the system
1988-90	Trisal	20 km	I	Farmers were provided with record sheets and asked for record keeping. A qualified graduate was engaged to supervise the programme.
			II	Same as system I + some medicines and concentrate feed were given free of charge.
			III	Farmers were provided with record sheets. Some medicines + concentrate feed were given free of charge. Nobody was engaged to supervise the programme. Farmers were asked for record keeping themselves.
			IV	Same as III + a record keeper was engaged (instead of a qualified graduate).
1991-1992	Trisal	20 km	V	A cooperative was formed with all farmers. All medicines + concentrate feed were supplied free of cost. Milk was sold to middle-men. A literate son of the farmer was employed as supervisor. Farmers were provided with record sheets and asked for record keeping.
			VI	A cooperative was formed with all farmers. All medicines + concentrate feed were supplied free of charge. Milk was sold to the Dairy Technology Laboratory of BAU at a fixed price for preparation of yoghurt and butter. The profit was used to purchase feedstuff, medicines and pay the salary of the supervisor who was the son of one farmer. Records were kept by the supervisor.
1998-1999	Trisal Bogra Noakhali	20 km 200 km 450 km	VII	A cooperative was formed. All farmers and their literate sons were trained on record keeping. Medicines and concentrate feed were supplied with record sheets. One trained son of a farmer of the cooperative was employed as record keeper and supervisor.

Results and discussion

The outcome of the seven tested systems is presented in table 3.

Table 3. Outcome of the seven tested systems for record keeping.

System no.	Merit	Demerit
I	No input cost involved.	1. No cooperation from farmers. 2. No record keeping. Selective breeding is not possible.
II	Farmers tried to cooperate.	1. Necessary cost for input supply. 2. Incomplete and inaccurate record keeping.
III	Farmers tried to cooperate.	1. Necessary cost for input supply. Record keeping was impossible due to lack of farmers' knowledge.
IV	Farmers tried to cooperate.	1. Necessary cost for input supply. 2. Record keeping was sometimes hampered due to negligence of the record keeper.
V	Farmers were interested. Record keeping was more accurate than in the four previous systems.	1. Necessary cost for input supply.
VI	Farmers and cooperatives were interested. No cost on-field is involved. Full recording was feasible. Selective breeding could be practiced.	A processing plant and selling centre were requested and were very expensive. It can be practiced on a cottage industry basis. It cannot be practiced on large scale operations.
VII	Farmers and cooperatives were interested. Full recording and partial recording were both feasible. Selective breeding could be practiced on small as well as large scale operations.	Demerits associated with the above six systems could be overcome except for the cost of salary of supervisors and training costs.

For small-scale operations for example, when the herd size is small and located in a small geographical boundary, system VI will be unique as already proved by the author (1994. Bangladesh Journal of Animal Science, 96-101). However, this system might be proved to be ineffective and unrealistic when we have to consider a greater geographical boundary as in case VII. System VII will be very effective, as already proved by the author (1998. First annual report. Bangladesh Agricultural University, Mymensing, p. 27). Through this system, selective breeding could be practiced whatever may be the management or whatever may be the distance of unit from the centre of evaluation as both partial recording (for example Bogra) and full recording (Trisal and Noakhali) are possible.

It can therefore be concluded that system VI will be effective for small geographical boundary and system VII will be effective for greater geographical boundary for accurate record keeping on productive traits of milk buffaloes in villages, for subsequent selective breeding.



Development of Buffalo breeding scheme in Thailand

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In South-east Asia, Thailand had the largest swamp buffalo population but has lost a considerable number with a negative annual growth rate of -17.34 percent per year since 1995. The number of buffalo has decreased every passing year (Department of Livestock Development, 1999); the present number is about 1.3 million and tends to decrease gradually. Sixty percent of the Thai population belongs to small-scale farmers who raise buffalo in the back yard. It was an integral part of the crop production system. The breeding units of buffalo per family hold on average five to ten heads from which no economic profit is made. There are very few farms that keep buffalo up to 50 head and manage as a commercial system where animals are fed good quality feed as well as having good management. Buffalo breeding in village conditions is generally random mating. In fact, in the plantation season the buffaloes are tied up and fed with rice straw for almost four months resulting in a lack of opportunity to be bred during the plantation time. The animals, males and females, are grazed together in the paddy fields after the harvesting season. Consequently, unplanned breeding occurs during the harvesting time when the villagers let the buffaloes graze together. It is obvious that in general, there is no recording system approach to the farmer level as in Government farms.

Regarding the Government breeding improvement point of view, in 1981 the National Buffalo Breeding and Research Programme in Thailand was established. The goal of the programme was to define the genetically superior buffaloes for sires and dams to be used and disseminate their merit to the farmers' animals. Buffalo breeding herds were set up at two stations at the beginning and then expanded to seven Government stations. The Lamphyaklang Livestock Research and Breeding Centre, in the central

**Buffalo
recording
system in
Thailand**

part of the country was established as the central test station where the performance testing programme was conducted as the selection tool for the buffalo improvement programme.

The Department's annual budget for those seven stations is currently around 35M Baht. There are 1 200 breeding buffalo cows and 60 bulls raised in the stations with the mating ratio of 20-25 cows to one bull by natural mating. The herd is divided to allow for three breeding timeframe categories to provide three lots of weaners per year in different periods due to the limitation of facilities. However, the number of animals recorded at each age group (birth, 200 days, 400 days and two year weight) dropped dramatically (Table 1) and the result from the data shows the undesirable low improvements which are partly due to the unselected animals sold after weaning with a perception that a weaning weight is enough for selection.

Table 1. General data of swamp buffalo in the analysis (record from 1981-1999).

Traits*	Bulls		Heifers		Total records
	No. of rec.	Avg. wt.	No. of rec.	Avg. wt.	
Birth wt.	3 767	29.9	3 866	27.6	7 633
200-day wt.	2 588	147.6	3 370	146.5	5 958
400-day wt.	728	211.6	660	199.8	1 388
2year wt.	578	334.6	484	327.4	1 062

* weight unit in kg.

Recording was made from every animal born on the research station for growth and fertility purposes. Growth traits are weighed at birth, weaning (around 240 days old) and all animals in every herd, every four months after that. Scrotal circumference was recently assigned for measuring from bull calves since they are weaned to identify a bull's own fertility and is genetically correlated with the fertility of his female relatives. Days to calving is measured also for cow fertility which is suited to natural mating under paddock conditions. The most fertile cows calf early, the least fertile cows calf late or not at all.

It is the combined work between the Government research farm and the Buffalo Research Group at the Department. Every research station has the same management system such as register and identification system, recording system, etc. The feeding regime is the decision of the station depending on the cost. Breeding and selection has been made through the performance test programme together with the genetic evaluation results which were decided by the animal scientist from the Department.

When the calf is born it is registered at the Department. Weight, body length, heart girth and height is weighed and measured within 24 hours after birth. The eartag system is used to identify the animal within a week.

The calf is allowed to be with its mother until weaned or about seven to eight months old. The animals will have their own pedigree papers with the data recording details. Cows and calves are weighed every two month. After the calves are weaned, they are selected according to their pre-weaning growth. From each weaning group, 60 top weight males are selected by the committee based on their 240 day adjusted weights, heights, average daily gains, appearance and conformation.

The general management of the performance test programme is implemented under the Government budget. The pre-selected animals are brought to the Central Test Station and are raised in the same management group for one year. They are given 15 percent protein supplemented feed for 1.5 kg per head with mineral block, *ad lib* hay and water. Weight, heart girth, height and body length were recorded monthly. Obviously before 1997, there was no formal index for these various traits and selection was by consensus amongst the committee. At the end of the test, average daily gain (ADG) and two year adjusted weights of the animals were calculated at the central station. The animals were ranked and selected based on two-year adjusted weight and appearances once again by the committee. The very first top ranking bulls are assigned for artificial insemination purposes. This AI practice is a service to farmers free-of-charge according to Government policy. The following ranked bulls are assigned for replacement bulls back to the breeding herds. The animals with average daily gain under 450 g were culled and sold for meat. It can be concluded that there is no breeding evaluation such as the animal EBVs or selection index weight to help make decisions. The young bulls cannot be compared with the older bulls by their individual performances so that the old bulls are kept in the herd to continually reproduce the offspring resulting in long generation intervals, thus, no genetic trend over years of recording. Since 1998 genetic evaluation has been made and selection is based on the genetic merit of the animals. Past data plus the present data are recorded using a software named Herd Magic which every research station has installed in their personal computers. Data are transferred monthly on to the database system at the central office where the mini computers are set up. The Estimated Breeding Values (EBVs) have been calculated from raw data input to the pedigree and performance database of buffalo herds of the Department. These results have been used as the tool for selection ever since.

Even though there are many difficulties for the practical recording operations at village level, such as difficulties for identification of the animals, disappearance of the animals, lack of weighing equipment, uncertainty in age determination, for increasing productivity and income for small farmers, on-farm recording under small farmers is now carried out with the unique objective of genetic improvement. Recently, the Government approached the projects such as “Cattle-Buffalo Bank Royal Project”, “Development of Livestock Production at Small-farmer Level” and “Genetic Dissemination by the Open Nucleus Breeding Scheme”, to

help farmers to raise more buffaloes and not to sell active female buffaloes to the abattoir. Farmers who join the projects are requested to record pedigree, date of birth and identification of the dam and if the sire is known. Weight is estimated through the correlation with heart girth and height of the animals. Those projects have received supplementary budget to help to establish smallholder farms, particularly in the areas where there is an emerging problem with rice and crop production.

**On-going
genetic
improvement
programme**

The Department of Livestock Development has been collecting data on various aspects of the growth and fertility of buffalo run on its seven (7) livestock research and breeding stations over the decades. The DLD has been collecting data on various aspects of the growth and fertility of beef cattle and buffalo run in its research and breeding centres. This is potentially one of the most comprehensive sets of performance records on beef cattle and buffalo bred in a tropical environment. Previously, most of the information was held in standard format on paper. There is an urgent need to incorporate it into a national computerised database where it can be used effectively to undertake the research which will provide the necessary genetic parameters for use in genetic evaluation and improvement programmes for buffalo and cattle in Thailand. Thus, in 1996 the Australian Centre for International Agricultural Research (ACIAR) supported the five year project "Genetic Improvement of Thai Beef Cattle and Buffalo" (PS1/9311) to assist the Department to set up a system of genetic evaluation, which used the theory of a multi-trait, animal model Best Linear Unbiased Prediction (BLUP) analysis to calculate Estimated Breeding Values (EBVs). This was one of the first national genetic evaluation schemes to use a multi-trait, animal model BLUP analysis.

There are buffaloes that were officially recognised as being of higher genetic value in the sire and dam summary which reports twice a year. To be eligible for the report, sires and dams in the listing have performance recorded progeny born in the last four years and have an accuracy of at least 60 percent for one of the traits.

Data recorded from 1981 to 1999 were entered into the database system all of which were the progeny recorded from 431 sires and 3 198 dams. The 1999 sire and dam summary reports EBVs for 79 registered sires and over 1 000 dams for up to five growth traits. The young sires as well as all heifer calves are reported similarly to the sire reports but these include information only on classified calves at two years of age who have at least two post-birth performance observations.

The GROUP BREEDPLAN software estimates the breeding values (EBVs) from which the analysis is based on the use of a multi-trait, animal model Best Linear Unbiased Prediction (BLUP) analysis for individual buffalo for seven traits which are birth weight, weight at 200 day milk, 400 day, 600 day, cow mature weight, scrotal circumference and day to calving. At

present, five growth traits are analysed. The fertility traits which need more data to make the results reliable will soon be analysed. EBVs of sires and dams all existing in DLD herds are published as the sire and dam summary annual report. The report also presents a listing of genetic merit for young bull and heifer buffaloes.

The software GROUP BREEDPLAN V 4.1 is developed by the Animal Genetics and Breeding Unit, University of New England, Australia. It produces across-herd EBVs (Graser *et al.*, 1987) and uses an implicit animal model and sparse matrix absorption to reduce computing costs (Tier and Graser 1991). Restricted Maximum Likelihood (REML, Meyer, 1993) procedures have been developed and used to estimate the necessary genetic parameters used in the analysis. EBVs for weights (birth to 600-day) and fertility traits have been analysed to rank the breeding buffaloes for selection. The fertility traits are scrotal circumference in bulls and the number of days from exposure to the bull to calving in cows (days to calving).

The organization responsible for the genetic evaluation of buffalo in Thailand is the Animal Husbandry Division, Department of Livestock Development. The development of breeding improvement programme can be divided into two phases.

Previously, selection was based on the performance test programme which was part of the National Buffalo Research and Development Project. This project operated under the guidance and supervision of the Research Implementing Committee who were the researchers from DLD and cooperating agencies. The performance test programme was conducted by a group of the Committee appointed from DLD and representatives from universities. Buffaloes from every test were judged and ranked based on their growth rate during the test and appearances.

Presently, the project involves research staff from the Agricultural Business Research Institute (ABRI), the University of New England's (UNE) Department of Animal Science, the Animal Genetics and Breeding Unit (AGBU) and the Tropical Beef Centre (TBC) collaborating with the Thai personnel in the DLD who are responsible for beef cattle and buffalo improvement. Since the ACIAR Project was implemented, animals have been genetically evaluated and interpreted by the staff geneticists. It is proposed that a coordination committee be established for the project as follows:

Thai Representatives

Director General, DLD

Director, Animal Husbandry Division, DLD

Director, Planning Division, DLD

Ancharlie Na-Chiangmai, Buffalo Research Group, as Project Leader

Australian Representatives

Mr P.A. Rickards, Managing Director, ABRI

Dr J. Vercoe/Mr J. Croaker, Alternative Delegates, TBC

Dr J. Copland, ACIAR

Dr H.U. Graser, Director, AGBU

The working staff consists of a computer system manager who is literate in computer systems with some software development experience and responsible for the central computer system and for coordinating the training of staff at the Research and Breeding Centres in use of personal computers for data capture; a PC expert/trainer appointed to the project for data collection, the transfer of data to the central computer and the use of word processing and other relevant PC software; and two data entry staff entering the past records to establish the central database. For research on genetic and breeding of buffalo, work has been undertaken by animal scientists supervised by the chief of the buffalo research group at the Department. Personnel in the research and breeding centres are given on-site training on how to capture their past records on PCs using software customised for the project. With this organization it is possible to achieve effective communication from the breeding stations to the central processing facility in Bangkok and then from the central processing facility to the Coordination Committee via the Project Leader.

The Department of Livestock Development through the Buffalo Research Group, Animal Husbandry Division now has 1 200 breeding dams being raised at its research stations. It has been planned to increase the number by at least 500 merit offspring per year according to the genetic dissemination by the Open Nucleus Breeding Scheme. Not only this implementation but also the buffalo research in various aspects is strongly recommended. Obviously, buffalo in Thailand is now classified as the native animal to be urgently researched under the genetic diversity and conservation aspects therefore the elite animals will be used as the source material in this regard. A genetic improvement programme has been set up as the DLD policy. The achievements of the programme are listed below.

**Elite herd
establishment and
genetic
distribution**

It is aimed at increasing the growth rate and fertility of these animals which makes them more profitable meat producers. Therefore, the buffalo elite herds are set up at two research stations. Selection of the merit animals through their EBVs for traits of interest is made from the result of BREEDPLAN analysis. Those buffaloes with high index EBV will be selected for replacement in the original herd for breeding improvement. The rest of them will be used in the multiplying herds and to the farmers. The excess sires and dams will be used in the multiplying herds at other Government stations as well as at the contracted farmers as the Government-farmer joint project (on-farm trial).

This programme is set up according to DLD priority. The farmers who join the programme have to sign a contract with the acceptance of the conditions made by the Department. The members have to record basic data while the officers will give advice and regularly investigate results. It is expected that about 400 000 buffalo cows in the country will be stable with efficient production.

The genetic improvement programme at small farmer level

Researchers from DLD, as the network coordinator and various universities and institutions will be encouraged to jointly research and develop the buffalo production technology in various branches as follows:

- a. Biotechnology research to increase efficiency in breeding distribution of the breeding-improved buffaloes as:
 - DNA finger print to identify livestock genetic merit which will bring about sustainable utilisation;
 - database system and bioinformatics for management of livestock genetic resources and related resources.
- b. Technology research and development study for increased production for consumption such as:
 - fattening potential of swamp buffalo for meat consumption;
 - raising methods in various forms.

Research and development on livestock biotechnology and genetic conservation

The computerised database is now being used effectively to undertake the research which will provide the necessary genetic parameters for use in genetic evaluation and improvement programmes for buffalo and cattle in Thailand. Results from GROUP BREEDPLAN analysis showed that there was a deficiency of linkage (sires in common) across all DLD stations. There was only a linkage between six herds out of 24. To make data the most useful in the analysis, linked sire either natural mating or artificial insemination is recommended. Results also show that there is no genetic trend over years of recording. This is probably not a good implication because the selection depends only on the phenotypes. It also shows little variation among the sires used because many of the sires used do not have daughters being used as replacements in the herds, thus the undesirable low genetic progress. Accordingly, the small population of the young animals was selected as the replacement made to the standardised selection differential of selected buffaloes was quite small. In addition, the buffaloes selected at two years of age were practically raised in the replacement herd until they were three to four years old. In the mean time, the old animals continued being used in the breeding herd. Another factor affecting the progress is that selected animals were not used as a replacement in the herds from where they came. Therefore, better animals not used in the herds thus delay the progress. As a result, the average generation interval of sires and dams was rather high, giving less genetic gain per year. It was concluded that the previous breeding plan needed to be developed to accelerate response of selection. The present system of sire selection from small Government herds is unsatisfactory, so

that the field recording of performance data and their utilisation alone or along with the farm data should be attempted to increase genetic gain through selection and movement of genetic material. The reproductive efficiency of the buffalo cow remains low and unchanged which limits the consistency of the annual genetic gain.

Buffalo recording system in Viet Nam

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Swamp buffaloes in Viet Nam are mainly raised by smallholder farmers with small herds (four to eight heads) partly for draught power and partly for meat. Traditional management dominates the buffalo production systems. Buffaloes are freely grazed on natural grassland, forests, roadsides, canal banks, rice fields after harvesting, dikes, etc. They are also fed rice straw or other crop residues in the dry season and working season. Observations and recordings on swamp buffalo performance are therefore, very limited. Farmers usually manage their buffalo herds based on their own experiences. Breeding selection of swamp buffaloes is almost neglected, except that farmers mate cows to good bulls, regardless of inbreeding, usually a field master bull is mated with all cows in a given area. The swamp buffalo performances are mainly observed and recorded from station experiments or on-farm trials. Murrah buffaloes and cross-breeds (Murrah x swamp) are mainly raised in the research station in small numbers, consequently, their performances are recorded and documented accurately. They are distributed in the north, central and south provinces of Viet Nam. There are some good demonstrations of raising Murrah buffaloes for work and milk in village conditions in the northern provinces. Diluted semen and frozen semen of Murrah bulls were successfully produced for artificial inseminations (AI) through financial and technical support from the Government of India, but they were poorly developed. In contrast, the AI services for cattle in villages are widely developed due to many acting projects for improving cattle productivity. In recent years there have been some difficulties with Murrah buffalo developments. The national indexes of buffalo performance have been updated in recent years. In general, buffalo productivity and reproductivity are less improved due to the limited resources of research and development. There is a need for international, technical and financial support to improve the performance recording systems and the productivity of both Murrah and Swamp buffaloes.

**Briefly
characterise
the buffalo
recording
system in Viet
Nam**

Material

Approximate number of recorded buffaloes. There are four Murrah buffalo herds; one in the South, one in Central and two in North Viet Nam. They make up 90 percent of the total number of Murrah buffalo herds in Viet Nam.

Approximate number of recorded buffaloes. There are approximately 500 recorded Murrah buffaloes.

Animal categories involved in the recording process. The categories of Murrah buffaloes recorded included offspring, males, females, parents, etc.

Purposes of the system. The purposes of the system are to improve the productivity and reproductivity of buffaloes, which are decided by the farms, projects and other studies.

Type of animal identification employed. The Murrah buffaloes are identified by the ear-cutting system.

Traits measured, frequency, etc. The traits measured are milk yield, milk fat, growth rate, meat production, feed conversion ratios, reproductivity and health care. In the research centres or experimental farms data were collected daily, weekly or monthly depending on types of traits or times necessary to measure.

Other information collected. Other data on buffaloes were also collected such as nutrition, feeding conditions, diets and health conditions.

Types of analyses of crude data. Data have been analysed in the experimental farms, research centres or institutes (projects).

Are data computerised and stored? Almost all data have been computerised and stored but some data have just been hand-written.

Who pays the recording; has this changed over time and if so why? The farms and projects mainly pay the recording. This has changed over time depending on the production development and research project funded.

Government and farmer involvement

Some projects relating to performance recording of the Murrah buffaloes received financial support from the Government. However, almost all the data recording was funded by the research projects or farms. The levels of acceptance of the scheme were average and it is necessary to improve the scheme.

We do not have any genetic improvement programme for buffalo. However, we have had some other projects relating to the productivity improvement of the Murrah buffaloes such as nutrition, supplementation, reproductivity, etc.

Are there buffaloes that are officially recognised as being of higher genetic merit?

Yes, there are Murrah buffaloes, which are officially recognised as being of higher merit. There are about fifteen Murrah bulls and fifty Murrah cows. They are observed every year in productivity. In the past (1978-1990) these numbers were higher, however, in recent years they have gradually reduced due to some difficulties of the Murrah buffalo development in Viet Nam.

How is their genetic merit established? The animals are individually observed in productivity.

The organization responsible for genetic evaluation. We have not yet had an organization responsible for genetic evaluation of buffaloes.

How is genetic improvement distributed all over the country? Mainly by natural breeding stations and limited AI activities.

In both Murrah and swamp buffaloes, we have not yet had a genetic improvement programme. However, in the past we had some Murrah development programmes funded by India relating to the improvement of productivity. Therefore, some selection programmes were realised in some Murrah buffalo farms. These programmes were finished for some reason which included lack of research and development funds, difficult development of Murrah buffaloes compared to dairy cattle, etc.

Genetic improvement programme for buffalo



Buffalo breeding in Armenia

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Due to the absence of animal recording, it is difficult today to know in detail the potential of buffaloes. Scientific research has been conducted in the past in the Republic of Armenia. However, it is worth noting that no other research and no selection have been carried out in Armenia in recent times. Since 1991 after the collapse of the former USSR all livestock of Armenia including buffaloes became totally privatised. After privatisation no precise livestock recording has been held and the data we now possess are merely the statistical data which were collected in the past. There are now about 1 000 buffaloes in Armenia.

The following is the most complete list and location of buffaloes in Armenia, although it is still incomplete:

- Kotayk region – 8 heads
- Synik region – 20 heads
- Lori region – 15 heads
- Ararat region – 89 heads
- Gegharkounik region – 30 heads
- Armavir region – 103 heads
- Tavush region – 205 heads.

For the present Workshop, a detailed survey was conducted, either by mail or by telephone. The purpose was to know the present situation of buffalo farmers looking for possible cooperative improvement projects that can be started within the activities of ICAR and the FAO Buffalo Network, as listed below.

1. Ararat Region – 80 buffaloes, one bull; all other age and gender groups are kept together, they all belong to one farmer who lives in the Masis Region and is considered to be the village chief (this information is received by telephone).
2. Synik Region, Sisian, farmer – Vova Azoyan, has 42 buffaloes, one bull; all animals are kept together.
3. Tavush Region, Noemberyan Subregion, Shavarshavan village; Vano Siradeghyan has 157 buffaloes, two bulls in the farm belong to him.
4. Armavir Region, Echmiadzin Subregion, Zeiva village. The farmer has 30 buffaloes and two bulls.

There are other buffalo farmers but it has been impossible to get in touch with them due to difficulties of communication. We believe that a development project on buffalo in Armenia is a fruitful goal to pursue. At present, buffaloes in Armenia are reared with the purpose of producing milk and meat; they are no longer used for draught. The following descriptive statistics indicate the type of animals.

Liveweight

Table 1. Liveweight of female buffaloes in Armenia (Madoyan O.A.).

Age	Liveweight	Livestock in the study
7 and more years old	484.4	356
6 years old	444.2	71
5 years old	423.8	84
4 years old	410.4	122
3 years old	360.4	61

Table 2. Liveweight of female buffaloes in different regions Armenia (Madoyan O.A.).

Regions	Liveweight, kg	Livestock in the study
Flat	492.4 (380-709)	289
foothills	460.0 (380-540)	34
Mountain, highlands	438.6 (300-540)	33

Table 3. Young buffalo liveweight (Madoyan O.A.).

Age, in days	Male			Female		
	Livestock	Fluctuations of liveweight	— X	Livestock	Fluctuations of liveweight	— X
New born	13	28-45	36.0	11	26-40	32.5
15	13	35-47	42.0	11	31-42	35.4
30	13	36-50	44.0	11	37-47	40.7
45	13	44-61	53.8	11	40-52	47.9
60	13	50-87	62.5	11	46-62	53.8
90	13	58-98	74.7	11	56-77	64.9
180	13	64-150	99.6	11	64-100	79.6
365	13	94-210	143.1	11	67-140	121.6

Buffaloes in Armenia have relatively low milk productivity. Below are the results of milk productivity research held in Armenia. At present, milk productivity has not increased as compared to the mentioned data, because no selection has been done in this respect.

Milk Productivity

The milk productivity of buffaloes at first calving is 930 kg, at second calving is 1 115 kg, at third and above, 1 120 kg.

Table 4. Milk productivity of buffaloes in kg (Madoyan O.A.).

Month of lactation	1 st lactation		2 nd lactation		3 rd lactation and above	
	No. animals	Avg. milk yield (kg)	No. animals	Avg. milk yield (kg)	No. animals	Avg. milk Yield (kg)
1	6	79	7	130	50	133
2	6	90	7	132	50	145
3	6	105	7	196	50	147
4	6	108	7	160	50	143
5	6	110	7	128	50	135
6	6	102	7	124	50	126
7	6	90	7	131	50	120
8	6	90	6	116	47	95
9	6	71	6	92	29	89
10	4	77	4	92	19	83

Table 5. Milk fat (percent) (Madoyan O.A.)

Month of lactation	1 st lactation	2 nd lactation	3 rd lactation or above
1	6.16	6.44	6.55
2	6.4	6.94	6.95
3	6.83	7.12	7.40
4	7.53	7.32	7.55
5	7.96	7.66	8.09
6	8.26	8.02	8.37
7	8.76	8.82	9.12
8	10.5	9.90	10.52
9	12.76	12.3	10.87
10	14.3	14.2	10.35
During the average lactation	8.26	7.73	7.88

Table 5. Milk fat percent (Madoyan O.A.).

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8	10.5	9.90	10.52
9	12.76	12.3	10.87
10	14.3	14.2	10.35
During the average lactation	8.26	7.73	7.88

Calving of buffaloes during the year:

January:	1.69 percent
February:	2.25 percent
March:	1.69 percent
April:	5.62 percent
May:	14.04 percent
June:	15.73 percent
July:	21.91 percent
August:	17.98 percent
September:	7.38 percent
October:	4.49 percent
November:	3.93 percent
December:	3.37 percent

The number of days between lactations, the service period when the buffaloes are not milked is on average 46 days (fluctuations 16-14 days), pregnancy duration 328 days (fluctuations 302 -361 days). Buffalo fertility on average is 86 percent. Females are first being mated at the age of three to four years old, males start to mate at the age of 2½-3½ years. Buffaloes can be used for 14-15 years.

No artificial insemination of buffaloes has been used or is used in Armenia. We use natural mating without any recording. At present, milk yield is used for the needs of the farmers, in some cases the milk is processed into cheese and butter and is then consumed.

Buffalo breeding in The Former Yugoslav Republic of Macedonia

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Number of buffaloes in the past years in The Former Yugoslav Republic of Macedonia is as follows:

- a. 1939 – 15 600 buffaloes;
- b. 1949 – 30 700 heads;
- c. 1959 – 22 000 heads;
- d. 1969 – 13 400 heads;
- e. 1979 - 9 300 heads;
- f. 1989 - 1 600 heads;
- g. 1997 - 1 013 heads and the number is falling, buffaloes being replaced by cattle.
- h. Herd type: in most cases 10-50 buffaloes per herd.
- i. Bulls: one bull for approximately 10 cows.

Bulls are born mainly in the same herd. To date in The Former Yugoslav Republic of Macedonia there has not been any breeding programme or planned mating.

Macedonian buffalo are black and have a height at withers of 129-131 cm, height at rump of 113 cm (111-146), body length 132-141 cm, chest depth 72.1 cm, chest girth 190 cm and they have a rectangular body frame.

AI is not practiced in buffaloes and the only way for mating is natural breeding without organization and selection. Most of the herds are settled in the less developed areas and near the rice areas or close to the rivers.

The system of keeping buffalo is as follows: there is a group of village people, each being assigned as a buffalo keeper on established days in the following month, the frequency of which depends on the number of his own buffaloes. At 6 a.m. every morning buffaloes, led by the chosen keeper, are taken to pasture around the village and move around until 5 p.m. Before going to pasture and after coming back home, they are hand milked only by their favourite milker.

After returning to the village, the keeper leads the herd to the centre of the village and from there each buffalo goes alone to his farmyard without a leader. From March to July they are repairing their body condition but from July to October in most of the lowlands the grass is dry and buffaloes often move up to the hill and mountain pastures together with sheep and cattle. From November to March they are kept in the village, tied and fed mainly with poor quality hay or straw without any concentrate.

The conditions on farms are very poor: buffaloes are tied to the ground, by rope, with no or little disinfecting of the udder and no milking equipment. Most of them are milked twice a day. The sheds are dark, with low ventilation (from the window) and without daily cleaning of the manure.

The breeding season starts in August and the delivering period is approximately in September. They are mated naturally, the female is taken to the buffalo bull by hand; the bull is kept separate from females.

There is no breeding station or progeny testing. No organized eartagging system or registration for buffaloes is in operation.

Milk production is the major purpose for rearing buffaloes.

- Milk yield in the lactation is near 600-800 kg milk with 7.5-9 percent of fat. The duration of the lactation is near to four to seven months, rarely nine months. Reproduction performances are good, each buffalo giving 10-12 calves per lifetime; longevity is often more than 20 years.
- The body weight of adult females is on average 505 kg, in adult males it is approximately 700-800 kg. The calves are born with a body weight of 32.6 kg (male) to 31.2 kg (female). Females are mated the first time at the age of 3½ years; 4 years for bulls.
- Meat production is not given a great deal of importance. Most of the male progeny is slaughtered at 5-10 months of age, after finishing or during the grazing period. The dressing percentage for all categories is near to 48-51 percent. Most buffalo meat from adult animals is used for processing.
- Milk is used mainly for processing; first it is skimmed, then processed into cheese or curd.
- Sometimes buffaloes are attacked by parasites and by leeches.

Buffalo recording in Iraq

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Recording at this stage is carried out on State farms only. There is only one buffalo farm of this sort. Private farms keep no records. A way must be master-minded to enter this closed circle. Standardised eartags must be provided when recording is commenced.

Recording

This is possible on State farms only, since expertise is available on these farms.

Follow-up of calf birth

On State farms, staff with expertise is available. Perhaps a further improvement will be necessary.

On private farms the problem exists. A special body must be designated and trained to carry out these tasks. Of course this creates a financial burden and a party is required to provide staff and funds?

At present no data bank or data processing centres exist in Iraq. However, data may be processed at any of the Iraqi universities or at the National Computer Research Centre for a nominal fee. If such a centre is established, under whose jurisdiction would it function? Would it be one of the universities or the Ministry of Agriculture?

Establishing a data processing centre

The importance of recording is still not realised by many and to organize field teams, the following must be considered:

- team members must be oriented with the importance of recording. They must also be trained for the systems of data collection;
- under which central administrative body should such teams operate?

Field teams

Approaching private farmers

Approaching private farmers is not an easy task. Most, if not all buffalo owners are uncooperative, reserved, traditionalist, superstitious, suspicious and not anxious to provide accurate information regarding the number of animals owned and their performances.

Warranting farmers' cooperation

To warrant private farmers' cooperation it is necessary to create incentives. Funds for such incentives must be provided. The question is what could such incentives be? From my experience, in 1968 I had provided a buffalo owner, free of charge, with concentrates in return for allowing me, personally, to supervise the milking of his buffaloes and take from each lactating buffalo a.m. and p.m. milk samples over a period of one year. That trial eventually provided the first information on yield and composition of Iraqi buffalo milk (see Trop. Agriculture 1970, 47: 171-174 and 175-179).

At the Agricultural Engineers' Union Conference in 1994, I submitted a paper on the importance of buffaloes in Iraq, its various performances, problems and shortcomings and reasons justifying its conservation and improvement as an animal genetic resource. The establishment of a buffalo research centre was also recommended. The recommendations were unanimously approved but unfortunately nothing has yet been done.



Part 2. The Workshop





Introduction

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This Workshop was promoted and supported by FAO and in particular by the Animal Production and Health Division, within the strategies for improving buffalo production in developing countries. We must thank Dr Maki-Hokkonen if we have succeeded in gathering so many participants from many countries interested in buffalo production.

The reason why so many different countries have been invited is that we believe that discussion is needed on the various on-going experiences before deciding to implement future cooperative activities. The people invited have many things to say to each other. However, they have had few opportunities in their own countries to discuss their issues, projects and goals with other experts. All of them have been involved to some extent and at some stage in the establishment of milk performance recording for buffalo in their country. Their experience is precious. Therefore, the major purpose of the Workshop will not be to examine existing systems of animal recording and the various experiences, but it is necessary that everybody frankly explains the constraints, difficulties, problems met as well as the obtained successes during the various trials of implementing animal recording systems.

The discussion will therefore be the focal issue of this Workshop. From the discussion, we will be able to draft recommendations and guidelines for establishing and maintaining successful buffalo recording systems. Moreover, the discussion will allow everybody to know each other better and to maintain continuous links in the future.

In order to finalise the discussion and for it to be more worthwhile for future outlets, we decided to divide the Workshop into four sessions:

- 1) *In Session 1* the seven most relevant case studies of milk recording performance in buffalo will be briefly presented and discussed. Then the participants will be divided into two working groups, so that each working group will be composed by no more than ten people. The two working groups will discuss separately, in two different rooms, for one hour, with a group leader for each session. At the end of each session, the two groups will meet together and each of the two group leaders will summarise the discussions and conclusions of the group.

In each of the three following sessions the two working groups will be led by a different group leader. Each session will be dedicated to answering a different topic, as follows:

- 2) *Session 2:* Justifications and components of a functional milk recording scheme (group leaders: R. Aleandri, Italy and A. Nigm, Egypt).
- 3) *Session 3:* Initiation and implementation of a functional milk recording system in countries where it does not yet exist. Identification of opportunities and constraints (group leaders: K. Trivedi, India and K. Juma, Iraq).
- 4) *Session 4:* Identification of the necessary components for establishing and maintaining a programme for the genetic improvement of dairy buffalo (group leaders: A. Georgoudis, Greece and Tz. Peeva, Bulgaria).

Sajjad Khan, Professor of Animal Breeding at the University of Faisalabad and Drona Rasali, Nepal Agricultural Research Centre, accepted to be the Chairperson and the Rapporteur, respectively, for the whole session, to ensure the running of the Workshop following the established schedule, to coordinate the plenary discussion and to help in drafting the conclusions and recommendations.

Both the Chairman and Rapporteur will participate in the discussions for the different working groups.



Figure 1. Drona Rasali (rapporteur) and Sajjad Khan (Chairman) during the discussion in Bled.

Session 1. Presentation of the seven most relevant cases of on-field buffalo recording

The Dairy Herd Improvement Programme Actions (DIPA) have been organized in a few selected districts in the State of Gujarat in India through the dairy cooperatives. Registration of buffaloes through eartagging and monthly milk recording have been integrated with milk collection, processing and marketing activities of the dairy cooperatives. Promoter of the DIPA is the National Dairy Development Board of India (NDDDB). NDDDB has developed its own software for recording inputs and providing feed-backs. As an incentive to farmers to participate in the programme, the dairy cooperatives give free concentrate in kind (about 350-400 kgs) for every daughter born under the programme over a period of one and a half years. Apart from providing an incentive to farmers, the practise of feeding concentrate to every daughter born under the programme has helped to improve calf rearing practises in the area and also helped in identifying true genetic differences by minimising some management differences.

Farmers have one to three or a maximum of five buffaloes. The information provided to each farmer about performance of his animals is not that important to him as the information provided for a whole village comparing performance of all animals within the village. An individual farmer knows everything about his animals and therefore a performance report for an individual animal does not add much to what he knows, but when the performance of his animals has been recorded in relation to all other animals in a village, the information becomes very relevant to him. He compares his performance with that of other farmers' animals in the village and tries to improve his animals' performance. It helps him in taking management and culling decisions. Thus, in generating information, each village is considered as a "herd". One finds considerable variability between villages and relatively less within the village. In estimating breeding values of animals, village-year-seasons are taken as fixed effects.

**India
(Gujarat),
presented by
Kamlesh
Trivedi**

**Bulgaria,
presented by
Tzonka Peeva**

The high yielding Bulgarian Murrah was created three decades ago by crossing Bulgarian buffalo with Indian Murrah. The cross-breeding programme was considered very successful and all of the Bulgarian buffalo population is now Bulgarian Murrah.

A well organized buffalo recording system has been in force for many years. However, after the collapse of the communist system, many difficulties have arisen. Buffalo recording and selection was based on the big cooperative farms: they used machine milking and were submitted to a complete selection programme: animal identification, milk recording, genetic evaluation, selection of bulls and bull mothers. No money is provided any more by the Government for such activities. The number of selection centres has fallen from 29 to 7. It is very difficult to convince farmers to pay for the recording and selection activity. Most farmers have one or two buffaloes. For full cooperation of the farmers in the recording activity, they should not be requested to pay any involved costs.

A Buffalo Breeders' Association was recently created. The participation of the farmers in this association, together with the lowering of the recording costs, could be a possible solution to the present crisis.

**Italy,
presented by
Riccardo
Aleandri**

A comprehensive system of milk recording and progeny testing programme is in operation, completely equivalent in the conduction to the system used for dairy cows.

Milk performance recording in buffalo started in 1974 with 1 451 recorded animals. In 1999 there were 31 133 recorded animals (20 percent of the Italian population) in 283 herds and 21 991 recorded lactations.

The Italian Breeders' Association supervises the milk performance recording, which is operated by staff of the local Breeders' Association. All data are centrally processed (Rome).

The breeding scheme was operated through five progeny testing cycles performed by distributing the semen of the bulls tested to private farmers. Pregnancy rate from artificial insemination increased from 0.26 percent at the first cycle to 0.39 at the third, being around 0.50 percent now (i.e. similar to the one for dairy cows). Today, 25 000 doses are available from 25 bulls, ten of which are proven bulls.

Dam selection is performed by independent culling levels based on the following:

- lactation milk yield over 3 100 kg
- fat percentage over 7.7 percent
- protein percentage over 4.5 percent
- udder score over good +
- assessment of sire and dam through DNA testing.

In Italy there is an adequate market of buffalo dairy products (mozzarella cheese) buffalo milk recording and selection can be performed in the same manner as that for dairy cows.

Eighty-five percent of 22 million buffaloes are kept by smallholders (one to five animals). In Punjab, the Livestock Production Research Institute, dependent on the Government of Punjab, has since 1980 carried out the progeny testing programme, involving both the research station, the State farms and the private farmers. Currently, 7 000 breeding females are recorded; the farmers do not pay; the milk record is performed on a monthly basis.

The progeny testing scheme was intended to evaluate 45 bulls, every year, with a minimum number of five daughters, in order to keep 20 proven positive bulls (50 percent discarded). The last evaluation was performed in January 1999, through an animal model. In Pakistan all recording and breeding activity is carried out by the Government, through its own institutions and staff.

In Nepal 3.3 million buffaloes are reared by smallholders (with one to five animals) throughout the country across the high mountains, middle hills and Terai plane. The milk recording system is at the introductory stage. Milk recording in buffalo is either carried out in institutional herds for farm management purposes or in farmers' herds for research trials, both are small in number. Lumle Agricultural Research Station has been recording milking buffaloes of the smallholder farmers (with one to five buffaloes) at a number of its Outreach Research sites in the western hills to compare performance of local and Murrah buffalo cross-bred buffaloes. Some incentives such as free technical advice to the farmers and free anthelmintics and vaccinations for their animals are provided to the participating farmers. As national breeding programmes have considered up to now only cross-breeding by Murrah to local buffaloes, a systematic genetic improvement programme based on milk performance recording is necessary taking into account the improvement of the local breeds (river type).

In Egypt the majority of buffaloes (97.5 percent) belongs to smallholders (one to five animals); only 0.3 percent of these buffaloes are milk recorded. Herds with over six buffaloes are 2.5 percent; in the larger herds 3.5 percent of the buffaloes are milk recorded.

The national milk recording activity is supervised by the Cattle Information System/Egypt (CISE), which records 1 200 buffaloes. The Animal Production Research Institute (APRI) performs the milk recording in the experimental and some commercial farms (2 000 buffaloes). Some universities and research institutes record 1 000 more buffaloes.

**Pakistan,
presented by
Munir
Chaudhry**

**Nepal,
presented by
Drona Rasali**

**Egypt,
presented by
Ali Nigm**

The CISE recording activity is performed according to the ICAR A4 method and the data are centrally processed.

Purposes of the recording activity are:

- improved farm management;
- genetic improvement;
- establishing a national dairy database to serve planning and research.

The following traits are measured and considered:

- milk volume;
- reproduction parameters;
- somatic cell count.

Data analysis is performed at CISE, which produces monthly feedback reports including:

- herd summary;
- attention list;
- individual cow information.

Involvement:

- the Government is not directly involved in the organization and processing of recording data;
- the Government pays the salaries to the part-time recording staff;
- national and international agencies support in some way the recording activity;
- some large commercial farms pay the recording costs.

Breeding programme:

- Cairo University started the progeny testing trial, but lack of coordination with the various institutions slows down the results of the trials;
- major constraints in running an efficient breeding programme are structural, cultural and financial.

Prompt efforts are being practiced to implement a “National Dairy Herd Improvement System (DHIS)” which was planned with FAO/Technical Cooperation Projects in 1997.

**Iran,
presented by
Reza
Mollasalehi**

The Animal Breeding Centre of Iran (Headquarters in Karaj) is a Governmental institution in charge of all livestock recording and selection activity. In Iran there are 7.5 million cattle (native, cross-bred and exotic) and 519 000 buffaloes. The buffalo herd size is on average five, ranging from one to 100 animals. Fifteen thousand buffaloes are officially milk recorded. Lactation milk production ranges from 1 600 to 2 000 kg milk. Farmers regularly receive the results of the recording activity.

Artificial insemination is performed yearly with fresh semen (7 200 inseminations) and frozen semen (1 800 inseminations).

The price of buffalo milk in Iran is twice as much as the price of cow milk. Making the records of buffalo performances available to the farmers may help to encourage them to participate in milk recording and selection programmes.

The main features of the seven on-going and effective cases of on-field milk recording for buffalo are as follows:

1. Farm management and selection of buffaloes are the main purposes of milk recording in four cases (Bulgaria, Egypt, Iran and Italy) while selection of breeding animals or cross-breeding at national or regional levels is the main purpose in three cases (India, Nepal and Pakistan).
2. Milk recording and selection activities are performed and controlled directly by the governments through their own established structures and staff in three cases (Iran, Nepal and Pakistan), by cooperative efforts of several institutions, including farmers cooperatives, in three cases (Egypt, India and Italy) and by farmers' associations in one case i.e. Bulgaria (it was being carried out directly by the Government).

Conclusions



Session 2. Justification and components of a functional milk recording scheme

**What are the benefits that the farmers receive from the recording activity?
Where does this activity exist?**

Discussion

The opinions are listed according to the priority assigned by the participants:

1. Milk recording activities make it possible to select animals which in turn leads to production of improved animals. Thus, milk recording and selection make available improved animals in the country.
2. Information provided through milk recording activities on individual animals or a group of animals on milk production, fat yield, growth, reproduction, etc. helps farmers in management and decision-making.
3. Farmers have the opportunity to sell some of their stock as breeding stock and get a much better price.
4. Farmers receive technical advice on feeding, health-care, reproduction and husbandry practices from the recording staff on their regular visits to the farmers' place.
5. Farmers participating in recording activities also receive the service of artificial insemination (mainly important for the smallholders that cannot afford to raise their own bulls).
6. In some cases farmers receive incentives in the form of free concentrates, medicines, etc.

Who pays the cost of recording activities? Where does this activity exist?

In most cases the governments meet 80 to 100 percent of the recording costs. In Bulgaria, the Government covers only 30 percent of the costs; in India (Gujarat State), the Government is not involved at all, the cost of recording is met by the farmers indirectly through their milk cooperative from the income generated from sale of their produce.

What were the major constraints that have been faced in order to implement the milk recording activity?

1. Farmers do not understand why production of their animals needs to be measured regularly by some external agency and are often suspicious about outsiders visiting their farms. They also do not want other farmers to know about productivity levels of their farm.
2. The establishment of a recording system requires identification of animals. Identification is expensive both for the devices to be applied and for the cost of the staff required for application.
3. In countries where the illiteracy rate is high (Bangladesh, Pakistan), it is impossible to rely on farmers for recording operations; in such cases more staff is needed for recording activities.
4. In some countries, smallholders are scattered in the countryside, far away from each other (Bangladesh, Nepal). The recording staff wastes a lot of time and spends a lot on petrol, driving miles and miles to record a few animals. Recording costs increase proportionally to the distance between the farms.
5. Lack of finance is the major constraint in initiating and sustaining recording activities (the major constraint in points 2, 3 and 4 above is availability of funds).
6. In Thailand and Viet Nam there is not much demand for buffalo milk; consumers do not drink milk because of some social, traditional reasons. As production of milk is not important, the importance of milk recording is also not that important.

How the constraints have been overcome in the countries where the recording activity has been initiated and sustained?

1. In cases where the Government recognises the importance of milk recording for increasing productivity of animals, they take full responsibility of supporting milk recording activities. Financial constraints in such cases have been overcome by financial support from governments.
2. Cooperation of the farmers could be obtained as in the case of Iran and Italy by providing useful information on production and reproduction at individual animal level and herd level for improving management of their farms.
3. In smallholder situations, cooperation of the farmers could be achieved by providing information that is relevant to them; for example, in India in the situation where farmers have just one or two animals, the

information available to farmers on the performance of individual animals may not be that important, but if the information on performance of all animals in the village is given, it becomes very relevant to an individual farmer as he compares the performance of his animals with other animals in the village and decides on the management of his own animals.

4. Cooperation of the farmers in the recording activity have often been obtained by giving them incentives in the form of free concentrates, free medicines and low cost semen doses, etc. (India, Iran).
5. By obtaining adequate funds from national or international agencies to initiate the recording system and possibly to provide part of the operational costs for an agreed period. Once the system is running, costs could be paid proportionally by beneficiaries.

Benefits provided by the milk recording systems include:

1. Animal recording is a prerequisite for any serious effort to develop livestock production at farm, industry or national level.
2. Data collected through recording activities can be used for:
 - extension services (feeding requirements, reproductive patterns, health-care) at farm and industrial level;
 - estimation of breeding values, selection of bulls and bull mothers at farm level and national level;
 - once data have been entered in a national database, they could be used for planning improvement strategies for buffaloes in the country.
1. No genetic improvement scheme can be implemented without milk recording.
2. Through regular visits of milk recorders, farmers receive technical advice on breeding, feeding, management and health-care of their herds.

Constraints were overcome by:

1. Increasing awareness of the benefits of milk recording to farmers (through meetings and discussions with the farmers organized by governments, cooperatives and research institutions).
2. Stimulating competitiveness between farmers.
3. Providing incentives: free concentrates, vaccines and semen doses.

Conclusions

4. Providing useful information (productive, reproductive parameters).
5. Financial constraints were solved by:
 - Government support to meet the majority of the costs; in such cases the system works (80 percent of cases); if the Government supports only a very small portion of the costs then the system collapses (Bulgaria);
 - farmers' cooperatives fully pay the recording costs by retaining the cost of recording from milk revenue. Here farmers indirectly pay the cost of recording (India).

Suggestions

Evolve simplified, low frequency recording systems to cut down the recording costs.

- application of simplified recording schemes: milk samples taken by the owner; alternate am/pm; bimonthly; trimonthly; once per lactation after testing the reliability of the system;
- record milk volume (no fat and protein);
- employ the extension staff more efficiently;
- consider village animals as one herd to cut down reporting costs.

Session 3. Initiation and implementation of a functional milk recording scheme in countries where it does not yet exist

Identification of opportunities and constraints in establishing and maintaining a functional milk recording scheme.

Why is a recording activity needed?

1. To know the actual situation of milk productivity at all levels (herd, village, national).
2. To provide information to farmers for decision-making, management and culling.
3. To provide information to policy-makers for decision-making and planning at national level.

Constraints faced (in the countries that do not have recording systems yet).

1. Buffaloes in general have very low productivity, therefore, the value of the animal is low.
2. Farmers are not aware of the usefulness of animal recording.
3. There are no leading institutions that can initiate a milk recording system.
4. There is a lack of skilled manpower for on-field recording and data collection.
5. There is a lack of expertise to organize a selection scheme (scientists, computer experts, etc.).

Proposed solutions

1. Initiate recording activity in large herds, where farmers will realise the benefits of recording and make use of information for decision-making and planning.
2. Initiate recording activity providing low cost useful information on individual animal: conception, pregnancy, fat percentage.

Discussion

3. In the case where the majority are smallholders they see no advantage in receiving management information for individual animals as they know everything about their animals, one should think about providing data at village level to encourage farmers to see their performance in relation to other farmers in the village and improve their own performance adopting the good practises followed by the better performing farmers. Create farmers cooperatives that can initiate and supervise recording activities.
4. Promote importance of recording among key decision-makers in governments of different countries to initiate buffalo recording.
5. Identify research institutions that offer skills and personnel to initiate recording systems on a small-scale in a selected group of farmers.
6. Recording activity can be initiated within an artificial insemination or progeny testing programme.

Conclusions

1. Initiation of recording schemes can be promoted by:
 - the government;
 - farmers' cooperatives;
 - research institutions.
2. In all cases it is necessary to promote awareness on the benefits of recording to all concerned people.
3. Recording could be initiated with medium-size herds.
4. Initially data collection could be restricted to important variables like conception, milk production, fat production, etc.
5. Recording activity can be initiated within an artificial insemination or progeny testing programme.

Session 4. Identification of the necessary components for establishing and maintaining a programme for the genetic improvement of dairy buffalo

Fifty percent of the participating countries have either an on-going programme at different stages or have recently concluded breeding programmes. In Azerbaijan and Bulgaria, the programme was successfully carried out in the past based on full governmental financial support. Due to the collapse of the State economy and consequent privatisation, breeding programmes have now been terminated as farmers cannot afford to pay the costs of maintenance of a recording system and breeding programme.

In Iran, Italy and Pakistan, breeding programmes are still effective, because there is a precise will of the Government to maintain them by guaranteeing the relevant funding.

India is the only example where the breeding programme has been successfully established and maintained by the farmers' cooperative, without any financial support from the Government. However, in this case the farmers do not pay directly for the services of recording and selection; the cost of the recording and selection programme has been met indirectly from the revenue generated by their cooperative union through the sale of their produce.

In India, Iran, Italy and Pakistan only one organization carries out all activities of the milk recording and genetic improvement programmes (i.e. recording, data processing, genetic evaluation, distribution of bulls, etc.). The same applied to Azerbaijan and Bulgaria when the programme was implemented.

However, in Egypt, the on-going breeding programme was implemented with the cooperation of several different institutions, including the cattle and buffalo breeders' associations.

Discussion

To what extent have genetic improvement programmes for buffalo been implemented at present?

Which organization is responsible for carrying out the genetic evaluation of buffalo?

How can a breeding programme be implemented and maintained successfully?

A breeding programme can successfully be implemented only with good infrastructure for artificial insemination and for milk recording. Some selected farmers having better animals could be involved in test mating programmes. Semen of proven bulls or of bulls produced using top proven bulls and top recorded daughters could be used for the entire population. Bulls produced using top proven bulls and top recorded daughters could also be used for a natural service programme.

Conclusions

To implement and maintain a successful breeding programme:

1. The breeding objective for improvement of buffaloes should be well-defined. If the breeding objective is the improvement of milk yield, the performance recording of milk yield as well as the method for calculating the lactation production must be standardised.
2. It is advantageous if a single organization supervises recording practises and carries out data processing work. The organization must develop good computing facilities and make use of advanced methodologies in evaluation of animals. It should also plan to receive long-term financial support for all its recording activities either from the local government or from other external sources (farmers, foreign agencies, international development projects).
3. Development of a good infrastructure for artificial insemination is a pre-requisite to any buffalo improvement programme. Developing infrastructure for identifying good bulls is one thing, but using identified bulls to a maximum in the base population is another thing. Dissemination of genetic material is only possible with a good artificial insemination infrastructure.

In the case where developing infrastructure for milk recording and for artificial insemination is not feasible in the country, a breeding programme could be organized within nucleus herds, where all tools of the genetic improvement could be applied. In this case, research institutions could be given the responsibility to implement the programme as they can offer scientific/technical expertise at all levels. It is recommended, however, that research institution's help must be sought to sensitise policy-makers in the need to initiate a recording and genetic improvement programme in the country.

Part 3. Recommendations



Part 3. Recommendations from the Buffalo Workshop

1. Animal recording is a prerequisite for any serious effort to develop livestock production at farm, industry or national level.
2. Data collected through recording activities can be used for:
 - extension services (feeding requirements, reproductive patterns, health-care) at farm and industrial level;
 - estimation of breeding values, selection of bulls and bull mothers at farm level and national level;
 - planning improvement strategies for buffalo in the country once data have been entered into a national database.

Nine important recommendations resulting from the Buffalo Workshop are given below.

Farmers should be made aware of the benefits derived from recording activities. They should be told that when a milk recorder visits his farm for a monthly visit, they receive advice on breeding, feeding, management and health care of animals from the milk recorder. It should be explained to the farmers that no culling or selection decision should be taken without recording performance of individual animals.

In the situation where the majority are smallholders they see no advantage in receiving management information for individual animals as they know everything about their animals. One should think about providing data at village level to encourage farmers to see their performance in relation to other farmers in the village and improve their own performance adopting the good practises followed by the better performing farmers. It also helps in the culling decision.

Providing an incentive to smallholders in the form of free concentrates, vaccines and semen doses, is also a good means to promote the recording activity.

At farmer level

At national level

- 1) Policy-makers should be made aware that no genetic, productivity or quality improvement can be pursued in any country or region without implementing milk recording. The government must provide financial support for implementation and maintenance of recording systems, at least in the early stages of implementation of recording systems. Financial support could also be obtained from international agencies and through international development programmes. Farmers could also be asked to pay for the recording and selection services after they see benefits of recording. In any case it is very difficult to convince farmers to pay for recording. If farmers form dairy cooperatives and such cooperatives are run at a profit then as shown by Indian experience, such cooperatives can support recording activities through the profit made from the milk business.
- 2) It is necessary to develop a low cost, simplified, low frequency recording system to cut down the recording costs. Some research trials can be carried out to evolve the required low cost recording systems.
- 3) Development of a good infrastructure for artificial insemination is a pre-requisite to any buffalo improvement programme. Developing an infrastructure to identify good bulls is one thing, but using identified bulls maximally in the base population is another thing. Dissemination of genetic material is possible only with a good artificial insemination infrastructure.
- 4) In the case where developing an infrastructure for milk recording and for artificial insemination is not feasible in any country, then a breeding programme could be organized within nucleus herds, where all tools of the genetic improvement could be applied. In this case, research institutions could be given the responsibility to implement the programme as they can offer scientific/technical expertise at all levels. It is recommended, however, that research institution's help must be sought to sensitise policy-makers on the need to initiate a recording and genetic improvement programme in the country.
- 5) The "national-scale" nature of the breeding programme should be emphasised to ensure sufficient data for accurate genetic evaluation and consequent genetic progress.
- 6) There could be a possible role for ICAR, FAO, the Working Group on Buffalo Recording, the Buffalo newsletter and the Task Force for a Developing Fund to support ICAR member organizations to establish and maintain their own breeding programme.
- 7) Coordination and close cooperation among various recording organizations within the country is essential to ensure uniformity and optimum utilisation of scarce local resources.
- 8) Exchange of experiences among buffalo recording organizations of different countries is also essential.

Part 4. Guidelines



Guidelines for simplified buffalo milk recording for low to medium input production systems

Buffalo milk recording activity in a country, region or district should be developed and supervised by a single organization, through its national, regional and/or local structures. The organization could be a public or private institution such as a research institute, farmers' cooperative, NGO or even a private company. To be sustainable it needs the official recognition of the concerned government ministry and the promotion and support of the stakeholders benefiting from milk recording.

Responsible organisation

To become internationally recognised the country and the milk recording organization needs to seek the membership of ICAR.

The farmer wanting to participate in milk recording must:

- accept the regulations of the recording organization;
- register his buffaloes under the animal identification system provided by the recording organization; and
- milk record all buffaloes of the herd.

Farmer's duties

Note: A herd could also refer to a group of herds in a village in cases where the individual herds are composed of a very small number of animals.

The milk recording activity is performed by trained technicians who have the following tasks:

- provide the farmer with the identification of all newborn calves;
- visit the herds according to the calendar established by the recording activity;
- register inseminations, matings, calving, deaths and dates of drying-off;
- weigh the milk produced by each individual buffalo at the two daily milkings (use the measuring devices approved by ICAR if they exist): milk must be weighed on a scale with sensitivity of at least 250 g or volumetrically measured with calibrated measures with sensitivity of 250 cc; and

Control technicians

- register milk production on the forms established by the recording organization.

Milk recording

1. Milk recording has to be carried out throughout the whole lactation.
2. Milk recording has to be carried out on all the buffaloes in the herd.
3. The first milk recording cannot be performed before the evening of the 5th day after calving.
4. The first milk recording must be performed within the 75th day after calving.
5. The minimum interval between two tests should be 25 days.
6. The maximum interval between two tests should be 46 days.
7. Due to proved and justified reasons, only one longer interval in one lactation can be accepted, provided that the number of days between two consecutive records does not exceed 75.
8. The milk record must be performed on all 24 hour milkings of the recorded herd; the time at which the recording is performed must be registered.
9. When at the recording visit the animal is found to have dried-off, the date of the drying-off of that animal is fixed at 14 days after the date of the last milk recording when she was still in milk.
10. In case the animal is found to have dried-off after the longer recording interval (46-75 days), the milk recorder is requested to ask the farmer the effective date for the drying-off. If the effective date falls within 30 days from the last recording, the date of the drying-off of that animal is fixed at 14 days after the last recording; otherwise, it is fixed at 44 days after the date of the last milk recording when the animal was still in milk.

Data processing

The organisation in charge is responsible for collecting and processing all the information registered by the technician.

The organization in charge will process and calculate the following:

1. Milk production of each buffalo during all the days she was in milking (total lactation production).
2. Milk production of each buffalo from calving to 270 days (270 days milk production).
3. Average values of total lactation production and 270 days milk production by herd, village, total covered area.
4. Average age at calving by herd, village, total covered area.
5. Average number of calvings by herd, village, total covered area.
6. Average days open by herd, village, total covered area.
7. Average days of lactation by herd, village, total covered area.

Parameters 1 and 2 will be used to produce individual buffalo certificates and will be processed whenever requested by the farmers.

Parameters from 3 to 7 will be processed at periods fixed by the organization in charge, according to the needs of the participating herds. In any case, annual average values of parameters 3 to 7 will be calculated for the total covered area to be sent yearly to ICAR.

Calculation of total lactation production will be done as follows:

- a. Partial production from calving to first milk recording: multiply milk production at first recording by the number of days from calving to first recording.
Example: date of calving 10 March; date first recording 6 April; milk production on 6 April: 3.2 kg. Therefore, partial production from calving to first milk recording = 3.2 kg x 27 days = 86.4 kg.
- b. Partial production during all milk recordings: multiply the average milk yield of two subsequent recordings by the interval between the two recordings.
- c. Partial production from last milk recording to drying-off day: multiply milk production at last recording by the number of days from last milk recording to drying-off.
 1. The date of milk recording when the animal is found to have dried off is 1 February: multiply milk production of last recording by 14 = 2 kg x 14 = 28 kg.
 2. The date of milk recording when the animal is found to have dried off is 23 February and the farmer states that the buffalo dried-off on 20 February: multiply the milk yield of last recording by 30 and add (last recording yield + (last recording yield/2)/2) * 14. Therefore: $(2 * 30) + ((2+1)/2) * 14 = 81$ kg.

Total lactation production is given by the sum of partial lactations (a) + (b) + (c). An example of calculation is reported in table 1.

Calculation of lactation production up to 270 days will be made as follows:

When the buffalo is still in milk at the recording date falling after 270 days, the average milk production of the two recordings bracketing 270 days is multiplied by 270 minus the number of days from the last recording before 270 days.

Example: In the above table the two recordings bracketing 270 days are 23 November (3 kg milk) and 3 January (2 kg milk).

23 November falls 258 days from calving; milk yield up to 23 November is 1 154.1 kg; therefore:

$(270-258) * ((3+2)/2) = 12 * 2.5 = 30$. Then $1 154.1 + 30 = 1 184.1$ kg.

The buffalo in the example will have a total lactation of 313 (or 343) days, total milk yield of 1 284.6 kg (or 1 337.6 kg) and 270 days yield of 1 184.1 kg.

When the buffalo dries-off before 270 days, total lactation yield and 270 days yield have the same value.

Table 1. Example of calculation of total lactation production.

Date of recording	Milk yield kg	Interval (days)		Average kg milk of two subsequent recordings	Yield of two subsequent recordings kg	Cumulative yield kg
10 March	Calving	27		3.2	86.4	
6 April	3.2	40		3.2	128	214.4
16 May	3.2	37		3.55	131.35	345.75
22 June	3.9	38		4.45	169.1	514.85
30 July	5.0	42		5.75	241.5	756.35
10 September	6.5	37		6.25	231.25	987.6
17 October	6.0	37		4.5	166.5	1 154.1
23 November	3.0	41		2.5	102.5	1 256.6
3 January	2.0	299 days				
1 February	dried	14	2		28.0	
23 February	dried	44	2+1.5			81.0
Sum		313	343		1 284.6	1 337.6

Lactation production of 270 days must be equal to or lower than total lactation production, never higher.

Note 1: Lactation milk yields, both total and of 270 days, are production parameters; they are not meant to express the genetic merit of the buffalo. Therefore, they should not be projected using extension factors. In case the lactation is very short for involuntary reasons, the reason will be mentioned in individual certificates by a code to be indicated beside the individual production e.g. (1) = sale; (2) accident, etc.

Note 2: When the 270 days milk production is used to calculate the average values by herd, village and total covered area, only the information from lactations having reached a minimum of 150 days will be used.

The responsible organization should produce three types of output:

1. Feedback reports to the farmers to help in management decisions. The reports should include: 1. Individual productivity sheets for each animal, including: genealogy; date of birth; date of calvings; total lactation production (number of days and total produced milk) for each lactation; 270 days lactation production (number of days and total produced milk) for each lactation; indication of interrupted lactation. 2. Average values of total lactation production, number of days in milking, 270 days lactation production (*), calving intervals, age at first calving, lactation number, by herd.
2. Information on buffalo milk productivity at village, region and/or national levels to extensionists, dairy industry, government authorities and policy-makers including: (average values of total lactation production, number of days in milking, 270 days lactation production (*), calving intervals, age at first calving, lactation number by village, area).
3. Information on buffalo milk productivity in the covered area to ICAR for international comparisons (same parameters as in 2.).

(*) Only the lactations over 150 days will be considered when the average 270 days production is calculated.

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Output produced by the responsible organization

Acknowledgement



Part 5. Annex



Annex 1. Working documents

No performance recording activity is feasible before the implementation of an identification and registration system which must be accepted and followed by all farmers who participate in the recording programme and where each animal can be uniquely and always recognised.

The identification and registration system has to register all farms and all animals, all movements of animals and trace back of individual animals. Only a few countries worldwide have a national identification and registration system covering all animals. Many identification methods are possible:

eartag, tattoo, earnotching, branding, paint marking, transponders (injectable, eartag and bolus).

In order to help implementation of animal identification systems, the major points of the on-going regulations on identification devices (ICAR International Agreement of Recording Practices, Section 11 and EU Regulation 820/97) are reported below.

The International Committee for Animal Recording is responsible for registration systems used in animal recording which include individual animal recognition through reliable permanent identification devices.

SECTION 1 - APPENDIX A OF ICAR INTERNATIONAL AGREEMENT OF RECORDING PRACTICES: METHODS OF IDENTIFICATION

Basic Principles

1. The recorded animal identity, must be the official identity of the animal in the member country and must be unique to that animal.
2. Where the identity of an individual animal is not unique, the record must so state (e.g. flock identities for goats/sheep). The identity number used for a flock or herd must be unique for that flock or herd.
3. The animals' identity must be visible.
4. The animals' identity should be unique and never be re-used.
5. The animals' identification device/method, must comply with legislative requirements.

Animal identification

ICAR regulations on animal identification

Additional Details

- a) The animals' identity number may be attached to the animal by a tag, tattoo, sketch, photo, brand or electronic device.
- b) Animals which lose their identity device must be re-identified and wherever possible, with their original number, provided that there is evidence that the animal is being correctly identified (where this is not possible, a cross reference to the original number must be maintained).
- c) Animals moving from one member country to another should, wherever possible, continue to be identified using their original identity number and name.
- d) In the case of imported animals, where the number has to be changed, the official records should also show the original number and name. The original number and name must be reported in Export Certificates, AI Catalogues and in catalogues of important shows and sales.
- e) Where an animal is identified using an implanted 'electronic device, the animal must be marked in a way which indicates the presence of an "electronic identification" device.

**Record of
identification
methods**

- a) The member organization must maintain a record of the approved identification methods used in the member country.
- b) The member organization must determine, within the constraints of the member country legislation, the identification methods to be used on recorded animals and herds or flocks.

**Standard
Identities**

The animal identity number will be a maximum of 12 digits (including check digits where used) and the ISO country code shall be added to identify the country of origin. Three digit numeric ISO codes must be used for data transfer and storage. In printed documents the ISO alpha country code should be used.

SECTION 11 - PERFORMANCE EVALUATION AND APPROVAL OF OFFICIAL PERMANENT IDENTIFICATION DEVICES (DRAFT)

Permanent identification devices are divided into two categories: simple identification devices such as conventional plastic or metal eartags, which may have machine readable symbology and electronic identification devices like RFID transponders and the corresponding transceivers.

Definitions concerning conventional permanent plastic eartags with or without machine readable printings.

Eartag

An eartag is composed of two or three principal elements:

- the front plate, which constitutes the so-called female part;
- the rear plate, which, when it includes the pin in the case of an eartag composed of two elements, constitutes the male part;

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- the pin, which constitutes the male part in the case of an eartag composed of three elements.

Manufacturer

The company or person that submitted the application or the approval of an eartag and accepted the conditions of ICAR for the control of production.

Reference colour

The colour of the eartags used in the laboratory tests is yellow with black printing. For field tests, the colour is the official colour used in the country in which the test takes place.

Reference eartag

The eartag model is used to show that test conditions on each farm are acceptable. Reference eartags are chosen by ICAR from among the models that have already been approved.

The Subcommittee on Identification of ICAR proposes a procedure for testing the performance and reliability of identification devices considering:

- ease of application and use;
- efficiency of animal recognition;
- durability and tamper-proof quality;
- issue of animal welfare.

The approval procedure is composed of different parts:

- a phase of formal application by the manufacturer where he undertakes to fulfil different requirements and provides technical information concerning the test product;
- a phase of laboratory tests;
- a phase of preliminary field tests, which can lead to provisional approval;
- continuation of the field test that can lead to full approval.

Further details of ICAR regulations and updating are available at www.icar.org

The establishment of the Single Market in the EU and the implications for intra-communitary and other international trade has made EU regulations a very important tool to be known, both in the EU countries that must implement the legislation at national level without any change and for the non-EU countries that want to export livestock into EU countries.

EU regulations for cattle identification are included in the Council Directive 820/97, in force since 1.07.1997.

EU regulations

These regulations state that today cattle and buffalo can only be identified by eartags in the European Union (EU); however, it is foreseen that transponders can be used from 2001 in national programmes.

The articles and paragraphs of the mentioned regulation 820/97 that are relevant to animal identification for performance recording purposes are listed below.

COUNCIL REGULATION (EC) No 820/97 of 21 April 1997 establishing a system for the identification and registration of bovine animals and regarding the labelling of beef and beef products.

*Title I - Identification
and registration of
bovine animals*

Article 1

1. Each Member State shall establish a system for the identification and registration of bovine animals (hereinafter referred to as 'animals'), in accordance with this Title.
2. This Title shall apply without prejudice to Community rules for disease eradication or control purposes and without prejudice to Directive 91/496/EEC and Regulation (EEC) No. 3508/92. However, those provisions of Directive 92/102/EEC which relate specifically to bovine animals shall no longer apply from the date on which those animals must be identified in accordance with this Title.

Article 2

For the purposes of this Title:

- 'animal' shall mean a bovine animal within the meaning of Article 2 of Directive 97/12/EC;
- 'holding' shall mean any establishment, construction or, in the case of an open-air farm, any place situated within the territory of the same Member State, in which animals covered by this Regulation are held, kept or handled;
- 'keeper' shall mean any natural or legal person responsible for animals, whether on a permanent or on a temporary basis, including during transportation or at a market;
- 'competent authority' shall mean the central authority or authorities in a Member State responsible for, or entrusted with, carrying out veterinary checks and implementing this Title or, in the case of the monitoring of premiums, the authorities entrusted with implementing Regulation (EC) No.3508/92.

Article 3

The system for the identification and registration of bovine animals shall comprise the following elements:

- a) eartags to identify animals individually;
- b) computerised databases;
- c) animal passports;
- d) individual registers kept on each holding.

The Commission and the competent authority of the Member State concerned shall have access to all information under this Title. The Member States and the Commission shall take the necessary measures to ensure access to this data for all parties concerned, including consumer organizations which have a particular interest or which are recognised by the Member State, provided that the data confidentiality and protection prescribed by national law are ensured.

Article 4

1. All animals on a holding born after 1 January 1998 or intended for intra-Community trade after 1 January 1998 shall be identified by an eartag approved by the competent authority, applied to each ear. Both eartags shall bear the same unique identification code which makes it possible to identify each animal individually together with the holding on which it was born. By way of derogation from the above requirement, animals born before 1 January 1998 which are intended for intra-Community trade after that date may be identified in accordance with Directive 92/102/EEC until 1 September 1998. By way of further derogation from the above requirement, animals born before 1 January 1998 which are intended for intra-Community trade after that date with a view to immediate slaughter may be identified in accordance with Directive 92/102/EEC until 1 September 1999. Bulls intended for cultural and sporting events (with the exception of fairs and exhibitions) may, instead of by an eartag, be identified by an identification system offering equivalent guarantees that have been recognised by the Commission.
2. The eartag shall be applied within a period to be determined by the Member State as from the birth of the animal and in any case before the animal leaves the holding on which it was born. That period may not be longer than 30 days up to and including 31 December 1999 and not longer than 20 days thereafter. However, at the request of a Member State and in accordance with the procedure referred to in Article 10, the Commission may determine the circumstances in which Member States may extend the maximum period. No animal born after 1 January 1998 may be moved from a holding unless it is identified in accordance with this Article.
3. Any animal imported from a third country which has passed the checks laid down in Directive 91/496/EEC and which remains within Community territory shall be identified on the holding of destination by an eartag complying with the requirements of this Article, within a period to be determined by the Member State of at most 20 days of undergoing the aforesaid checks and in any event before leaving the holding. However, it is not necessary to identify the animal if the holding of destination is a slaughterhouse situated in the Member State where such checks are carried out and the animal is slaughtered within 20 days of undergoing the checks.

The original identification established by the third country shall be recorded in the computerised database provided for in Article 5 or, if this is not yet fully operational, in the registers provided for in Article 3, together with the identification code allocated to it by the Member State of destination.

4. Any animal from another Member State shall retain its original eartag.
5. No eartag may be removed or replaced without the permission of the competent authority.
6. The eartags shall be allocated to the holding, distributed and applied to the animals in a manner determined by the competent authority.
7. Not later than 31 December 2000 the Council, acting on the basis of a report from the Commission accompanied by any proposals, shall decide on the possibility of introducing electronic identification arrangements in the light of progress achieved in this field.

Article 5

The competent authority of the Member States shall set up a computerised database in accordance with Articles 14 and 18 of Directive 97/12/EC.

The computerised databases shall become fully operational no later than 31 December 1999, after which they shall store all data required pursuant to the aforementioned Directive.

Article 6

1. As of 1 January 1998 the competent authority shall, for each animal which has to be identified in accordance with Article 4, issue a passport within 14 days of the notification of its birth, or, in the case of animals imported from third countries, within 14 days of the notification of its re-identification by the Member State concerned in accordance with Article 4 (3). The competent authority may issue a passport for animals from another Member State under the same conditions. In such cases, the passport accompanying the animal on its arrival shall be surrendered to the competent authority, which shall return it to the issuing Member State.

However, at the request of a Member State and in accordance with the procedure referred to in Article 10, the Commission may determine the circumstances under which the maximum period may be extended.

2. Whenever an animal is moved, it shall be accompanied by its passport.
3. By way of derogation from the first sentence of paragraph 1 and from paragraph 2, Member States:
which have a computerised database which the Commission deems to be fully operational before 1 January 2000 in accordance with Article 5, may determine that a passport is to be issued only for animals intended for intra-Community trade and that those animals shall be accompanied by their passports only when they are moved from the territory of the Member State concerned to the territory of another Member State, in which case the passport shall contain information based on the computerised database.

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- In these Member States, the passport accompanying an animal imported from another Member State shall be surrendered to the competent authority on its arrival which may, until 1 January 2000, authorise the issue of collective animal passports for herds moved within the Member State concerned provided that such herds have the same origin and destination and are accompanied by a veterinary certificate.
4. In the case of the death of an animal, the passport shall be returned by the keeper to the competent authority within seven days after the death of the animal. If the animal is sent to the slaughterhouse, the operator of the slaughterhouse shall be responsible for returning the passport to the competent authority.
 5. In the case of animals exported to third countries, the passport shall be surrendered by the last keeper to the competent authority at the place where the animal is exported.

Article 7

1. With the exception of transporters, each keeper of animals shall:
 - keep an up-to-date register;
 - report to the competent authority, once the computerised database is fully operational, all movements to and from the holding and all births and deaths of animals on the holding, along with the dates of these events, within 15 days and as from 1 January 2000, within seven days of the event occurring. However, at the request of a Member State and in accordance with the procedure referred to in Article 10, the Commission may determine the circumstances in which Member States may extend the maximum period.
2. Where applicable and having regard to Article 6, each animal keeper shall complete the passport immediately on arrival and prior to departure of each animal from the holding and ensure that the passport accompanies the animal.
3. Each keeper shall supply the competent authority, upon request, with all information concerning the origin, identification and where appropriate, destination of animals which he has owned, kept, transported, marketed or slaughtered.
4. The register shall be in a format approved by the competent authority, kept in a manual or computerised form and be available at all times to the competent authority, upon request, for a minimum period to be determined by the competent authority but which may not be less than three years.

Article 8

Member States shall designate the authority responsible for ensuring compliance with this Title. They shall inform each other and the Commission of the identity of this authority.

Article 9

Member States may charge to keepers as referred to in Article 2, the costs of the systems referred to in Article 3 and of the controls referred to in this Title.

Article 10

The Commission shall adopt detailed rules for the implementation of this Title in accordance with the procedure laid down in Article 13 of Regulation (EEC) No 729/70. These detailed rules shall cover in particular:

- a) provisions concerning eartags;
- b) provisions concerning the passport;
- c) provisions concerning the register;
- d) minimum level of controls to be carried out;
- e) application of administrative sanctions;
- f) transitional provisions for the start-up period of the system.

The full text of EU Regulation 820/97 is available at <http://europa.eu.int/eur-lex>

**Methods of
recording
performances**

SECTION 1. APPENDIX C OF ICAR INTERNATIONAL AGREEMENT OF RECORDING PRACTICES

1. The ICAR Agreement under Section 6 allows organizations a degree of freedom in deciding recording practices.
2. For each type of recording the predominant traits being recorded shall be used to determine the appropriate ICAR method classification.

Method A.

All the recordings are undertaken by an official representative of the Recording Organization. This includes recordings undertaken by approved on-farm systems that are supervised by an official representative of the recording organization and that cannot be manipulated by the farmer or his nominee;

or

Method B.

All the recordings are undertaken by the farmer or his nominee;

or

Method C.

The recordings are undertaken by the farmer or his nominee and by an official representative of the Recording Organization.

3. For official records an ICAR approved supervisory system must be maintained and check data regularly documented to provide authentication for the records.
4. ICAR Members must ensure that any of their associate recording organizations fully comply with ICAR approved recording methods and practices.

SECTION 1. APPENDIX D OF ICAR INTERNATIONAL AGREEMENT
OF RECORDING PRACTICES

**Individual
animal
certificates**

Basic Principles

1. An official certificate must contain all the information essential to establishing the identity and value of an animal.
2. An official certificate must clearly indicate the recording methods used to produce the official record.
3. An official certificate must contain the latest information available on the date of issue.
4. Where any 'estimated' information is included in an official certificate, this must be clearly indicated.

The following details must be reported:

- a) The ICAR member organization issuing the certificate.
- b) The date of issue of the Certificate.
- c) The identity number and name of the animal.
- d) The animal's "original number" and name, if different.
- e) The name of the register in which the record is held.
- f) The date of birth of the animal.
- g) The identity and names of the animal's sire and dam and of its grand sires and grand dams.
- h) The breed of the animal, or in the case of cross-bred animals, the main breed percentages in the animal's breeding.
- i) The sex of the animal.
- j) The animal's genetic evaluation.
- k) The animal's records of production.
- l) The animal's type classification evaluations.
- m) That the animal is a known carrier of a genetic defect, defined by the International Breed Federation concerned.
- n) Any events which have significantly affected the animal's records e.g. Alpage, sickness and hormonal treatments.
- o) The location of the animal on the date of the last recording.
- p) The methodology used in the production of the record, where this is other than the Reference Method.

The following details may be reported:

- a) The name and address of the breeder of the animal.
- b) The date of the animal moved to the present location, if other than the date of birth.
- c) The date of commencement and the end date for each period production record.
- d) The events which started and ended each production period.
- e) The individual recording day production records.
- f) Any health event recorded for the animal.
- g) The dates and service sire of any recorded services.
- h) The identity and sex of any progeny of the animal.
- i) If the animal has been flushed to produced ova, the flushing dates and the number of viable ova collected.

- j) If the animal has been used as a ‘recipient’ following ET, the date of transfer, the genetic sire and dam of the embryo and the sex of the embryo.
- k) The fertility records of the animal, including its current fertility status.
- l) Additional trait records and evaluations, such as milkability and locomotion scores.
- m) The death of the animal.
- n) The number of true recordings (no missing values) contained in the record for each production period.

Milk recording

Symbols used on records

Two milkings per recording day is the reference method.

Recordings other than by the reference methods must be indicated using the appropriate following symbols:

Number of milkings per day	Symbol
Once a day milking	1 x
Three milkings	3 x
Four milkings	4 x
Continuous milking (e.g. robotic)	R x
Regular milkings not at the same time on each day (e.g. 10 milkings per week)	1.4 x
Animals that are both milked and suckled	S x
Where the herd is recorded at one milking at one recording visit and a different milking at the next recording visit	T
Where the herd is recorded at the same milking at one recording visit	C

Method for lactation calculation (A4)

Milk recording intervals

The A4 method is the only method at present applied for milk performance recording in buffalo to obtain the official ICAR stamp. According to this method, the acceptable interval between recordings is a maximum of 33 days (average of all recording intervals in the lactation).

The A6 method (acceptable interval between recordings is a maximum 46 days) was proposed to ICAR in the International Agreement for Milk Recording in Buffalo (June 1999).

For simplified methods, refer to Section 2.1 of ICAR International Agreement of Recording Practices at www.icar.org

General rules (A4)

- Milk recordings must be effected during the whole lactation;
- official lactation starts the day after the calving date;

- first milk recording cannot be performed before the 5th and after the 75th day of calving;
- interval between two recordings must be minimum 26 days and maximum 33 days;
- for justified reasons, only one interval up to 75 days (but not longer) can be accepted in each lactation; if this longer interval reaches 100 days, the lactation can be calculated but mention of the irregular recording must be done;
- when at the recording visit, the animal is found to have dried-off, the date of the dry-off of that animal is fixed at 14 days after the date of the last milk recording when still in milk;
- in case the animal is found to have dried-off after the longer recording interval (33-75 days), the milk recorder is requested to ask the farmer the effective date for the dry-off. If the effective date falls within 30 days from the last recording, the date of the dry-off of that animal is fixed at 14 days after the last recording; otherwise, it is fixed at 44 days after the date of the last milk recording when the animal was still in milk.

Calculation of lactation production:

- Partial production from calving to first milk recording: multiply milk production at first recording by the number of days from calving to first recording.
Example: date of calving 25 March; date first recording 6 April; milk production on 6 April: 8.2 kg. Therefore, partial production from calving to first milk recording = 8.2 kg x 12 days = 98.4 kg.
- Partial production during all milk recordings: multiply the average milk yield of two subsequent recordings by the interval between the two recordings.

Example:

Date of recording	Interval	Milk yield kg	Average kg milk of two subsequent recordings	Total yield of two subsequent recordings kg
6 April		8.2		
6 May	30	12.5	10.3	309.0
5 June	30	14.6	13.5	405.0
7 July	32	15.5	15.0	480.0
2 August	26	10.0	12.7	330.2
30 August	28	7.0	8.5	238.0
Sum				1 762.2

- c. Partial production from last milk recording to dry-off day: multiply milk production at last recording by the number of days from last milk recording to dry-off:
- 1) The date of milk recording when the animal is found to have dried off is 25 September: multiply milk production of last recording by 14 = $8.5 \text{ kg} \times 14 = 119 \text{ kg}$.
 - 2) The date of milk recording when the animal is found to have dried off is 10 October: multiply half of the milk production of last recording by 44 = $4.25 \text{ kg} \times 14 = 187 \text{ kg}$.
- Total lactation production is given by the sum of partial lactations (a) + (b) + (c).
Therefore:
Case 1: animal found to have dried-off on 25 September: $98.4 + 1\,762.2 + 119 = 1\,976 \text{ kg}$
Case 2: animal found to have dried-off on 10 October: $98.4 + 1\,762.2 + 187 = 2\,044 \text{ kg}$

Lactation duration

For buffalo, as for cattle, two lactation durations and corresponding milk production are reported for each animal on the lactation certificates and on the various publications:

- total lactation production;
- standard lactation production.

Total lactation production is the milk effectively produced by the animal during all the days it has been milked.

Standard lactation production is the milk effectively produced by the animal during a number of days corresponding to the average lactation duration of the buffaloes in that country.

Standard lactation duration is fixed by each country or recording organization.

Standard lactation production is useful to compare production of different animals having different lactation duration.

Calculation of the standard lactation production:

- partial lactation (a) and (b) are calculated as for the total lactation production;
- partial lactation (c) is calculated as for the total lactation production if the date of the dry-off falls before the fixed number of days for standard lactation.

Otherwise, if the animal is still in milk at the recording following the end of the fixed standard lactation duration, the average milk production of the two recordings (before and following the standard end of the lactation) is multiplied by the number of days from the recording before the standard end to the date of the standard end.

Standard lactation production must be equal to or lower than total lactation production, never higher.

(Draft agreed by the ICAR member countries of the ICAR WG on Buffalo Recording, June 1999)

Purpose

Milk recording in buffalo concerns:

- milk yield produced in lactation;
- fat content (optional);
- protein content (optional).

Organisation in charge

Milk recording is supervised in every country by the ICAR member organization. This organization is responsible for:

- preparing sheets and books for data collection;
- processing the data;
- printing of the lactation certificate;
- publishing an annual report;
- supervising all activities in the farm and in the offices.

Farmers' duties

The farmer wanting to participate in milk recording must:

- accept the regulations of the recording organization of his country;
- identify his buffaloes with the required method (uniquely numbered eartag);
- milk record all buffalo of the herd.

Technicians

The milk recording activity is performed by trained technicians who have the following tasks:

- provide all new-born calves with the identification mark within the established deadline;
- perform monthly recording;
- register inseminations, calving, deaths.

Milk recording

- milk recording has to be carried out during the whole lactation;
- milk recording has to be carried out on all the buffaloes of the herd;
- milk yield must be registered;

International agreement for milk recording in buffalo

- fat and protein percentage can be determined;
- standard lactation duration is established in 270 days; in any case, also total lactation duration and production must be indicated for all buffaloes;
- lactation starts on the first day after the day of calving;
- the first milk recording cannot be performed before the evening of the seventh day after calving;
- interval between two tests should be either 28-33 days (A4 method) or 38-46 days (A6 method). The method should be chosen by the farmer and must cover all buffaloes during the whole lactation. The method must also be stated in the documents in which the lactation records are reported;
- due to proved and justified reasons, one record in one lactation can be skipped, provided that the number of days between two consecutive records does not supersede 75; in case the skipped record is the first, it must be performed no later than the 60th day from calving;
- the milk record must be performed on all 24 hours milkings of the recorded herd; time at which record is performed must be registered; if necessary according to the opinion of the technician, another record will be performed at milking before those officially recorded;
- milk yield can be expressed either in kg or in litres;
- milk must be weighed on a scale with sensitivity of at least 250 g or volumetrically with calibrated measures. Milk meters and recording jars can be approved by the ICAR member organization of each country after appropriate trial. Results of the trial will be sent to ICAR. Approved milk meters and recording jars as well as the country in which they were approved are indicated in the appendix of the present regulations;
- in case fat/protein contents are determined, samples must be collected from all buffaloes and for the whole recording duration. Samples may be taken by any of the following methods:
 - a) a sample for each milking;
 - b) a proportional composite sample for all milkings within the 24 hour test period;
 - c) alternate (i.e. am/pm) samples on consecutive sampling days;
 - samples must all be added with the allowed preserving drug according to the analysis system used;
 - milk analysis must be performed no later than four days from the day of recording;
 - methods for the analysis of milk components are the official ones approved by ICAR for cattle.

Data processing

The following items will be registered and considered in the data processing:

- age at calving;
- date of calving and calving number;
- days open;

-
- days of lactation;
 - number of milkings in 24 hours;
 - diseases during the recording;
 - lactation yield is calculated using the Fleischmann method;
 - calculation of fat yield (kg) and protein yield (kg) will be done in the same way as for milk;
 - average fat and protein percentage will be calculated as follows:
(kg fat (or protein) * 100)/kg milk;
 - the following parameters are suggested for processing and publication of statistics:
age at first calving; calving interval; number of calvings and total yield for each buffalo in the whole life-span; number of inseminations/pregnancy; date of first estrus after calving.

Authorised milk measuring systems.

Name	Type	Country of approval
Milko Scope II	Milk meter	Italy
Alfa-Laval 7274031-80	Recording jar	Italy
Tecnozoo	Recording jar	Italy



Annex 2. List of participants

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