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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Development of Successful Animal Recording Systems for Transition and Developing Countries

Proceedings of the FAO/ICAR Seminar
held in Interlaken, Switzerland,
27 May 2002

Editors: J. Mäki-Hokkonen, J. Boyazoglu, T. Vares & M. Zjalic

July 2002

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Welcome address to the FAO/ICAR-Seminar

Ladies and Gentlemen,

As President of the International Committee for Animal Recording (ICAR) I welcome you to this Seminar on the development of successful animal recording systems for transition and developing countries.

I would like to thank very much the Food and Agriculture Organization of the United Nations (FAO), in particular, Dr. Samuel Jutzi and Dr. Juhani Maki-Hokkonen of the Animal Production and Health Division (AGA), for their support.

I thank the local organizers in particular Dr. Ulrich Witschi, Dr. Christoph Böbner, Dr. Hans Rätzer and Mr. Fritz Schneider, for the very good work they have done.

ICAR is today the worldwide organization for the standardization of animal recording and productivity evaluation. Its aim is to promote improvement of farm animal recording and evaluation trough the formulation of definitions and standards for the measurement of traits of economic importance.

ICAR's mission is to provide benefits to its member organizations through actions that they cannot do efficiently themselves:

- providing information and services which help member organizations to develop, operate and manage their business;
- providing information and services which promote benefits of recording and evaluation, thereby increasing the demand for the services provided by ICAR member organizations;
- providing guidelines and standards which facilitate the provision of services and the exchange of information by member organizations both nationally and internationally; and
- providing a body through which member organizations can work together to achieve shared objectives.

The present structure of ICAR as a registered non-profit INGO provides for full participation of its members in developing - among other things - guidelines and recommendations on the basis of the sound scientific evidence. Guidelines represent a minimum of the requirements set up to ensure a satisfactory degree of uniformity of recording among member countries and a maximum flexibility in the choice of methods.

The signing of the International Agreement is the main commitment of any member when joining the organisation. Actually ICAR has 60 member organisations in 49 countries.

The success of ICAR's activity depends on the work of its 3 Sub-Committees, its 12 Working Groups and Task Force.

During the last years, ICAR has organised the following five international workshops with the active support of the FAO and EAAP:

- in Anand (India) in October 1997 on animal recording for smallholders in developing countries;
- in Warsaw (Poland) in August 1998 on cattle identification and milk recording in Central and Eastern European Countries;
- in Bella (Italy) in September 1999 on developing breeding strategies for lower input animal production environments;
- in Bled (Slovenia) in May 2000 on the role of breeders' organisations and the state in animal identification and recording in CEE countries; and
- in Bled (Slovenia) in May 2000 on animal recording for improved breeding and management strategies for buffaloes.

This seminar will offer you the possibility

- to discuss cases of successful adaptation or implementation of animal recording in conditions of economic transition or dynamic structural change;
- to get insight view of the issues of success in institutional, structural and management changes and transitions experienced in animal recording involving market oriented animal production systems at various levels of intensity;
- to evaluate the needs for research and development in livestock recording systems as well as training need for decision makers and stakeholders in transition and developing countries;

- to make recommendations to ICAR and FAO to address the issues which are in their sphere of influence; and

- to exchange experiences among the participants.

I am pleased that several representatives of 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.

Maybe in the next years, some of these non-member countries will join ICAR and share common objectives with the other organisations.

I wish you a very interesting seminar, a successful ICAR Session and a pleasant stay in Switzerland.

Joseph Crettenand
President of ICAR

Preface

J. Mäki-Hokkonen

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The 33rd session of ICAR and Interbull meeting were held in Interlaken, Switzerland from May 26 to 31, 2002. In this connection a joint ICAR/FAO Seminar was held to discuss how sustainable livestock development can be enhanced in developing and transition countries through efficient organization of animal recording and skills development. This was a logical sequence to the several other meetings which ICAR, FAO and EAAP have sponsored and organised in recent years in Anand, India (1997), Warsaw, Poland (1998), Bella, Italy (1999) and two workshops in Bled, Slovenia (2000) to promote animal recording in developing regions of the world.

Several trends in livestock production have an impact on the organization of animal recording. Rapid increase of demand for animal products is taking place in developing and transition countries along with the increase in commercialization and intensification of animal production. This happens both in the rural family based systems as well as in private sector industrial type of dairy, pig and poultry production systems in many CEE and CIS countries and peri-urban areas in the developing countries.

This coincides time wise with the withdrawal of the public sector from the animal production and processing and limiting itself to policy, legal, regulatory and other similar public functions. Decision making power on animal resource planning and management is being increasingly decentralised to local level stakeholders which necessitates major transitions and adjustments in the institutions involved in livestock and related skills developments. Favourable enabling environment exists to enhance private sector initiatives to develop decision support tools like animal recording at farm, community and national level and growing awareness regarding the sustainable use of animal and plant bio-diversity.

The focus of the workshop was on the capitalization and sharing of experiences of the successful use of animal recording systems in livestock development in the transition and developing countries. The workshop particularly aimed at addressing the issues of adaptation of animal recording organizations in the transitory changes resulting from major shifts in the livestock sector. It also discussed how ICAR and its member countries or potential new members in the developing world could benefit from attracting greater participation in animal recording of livestock farms; farms at different levels of production intensity or scale of operation regardless of the breeds or species of animals they keep.

Trends in animal agriculture in developing countries and implications on animal recording

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Summary

This paper makes a review of the past trends and future forecasts in animal agriculture based on a recent FAO and World Bank publication on world perspectives of agricultural development based on farming systems evolution in six developing regions of the world. Animal agriculture perspectives are analysed in five of the six regions excluding the Eastern Europe and Cental Asia Region which is covered in an other FAO paper of this Seminar. The analysis shows that in general the output and productivity of the main livestock farming systems have grown remarkably over the past 30 years particularly in the regions of Asia and Pacific and Middle East and North Africa. This has been and is predicted to continue to be driven by the demand stimulus provided by domestic urban economic growth and increasing human population. The major Latin American livestock systems evolution is driven either by strong demand for beef meat in the international market or increasing urban demand boosting intensive dairy, pig and poultry systems in urban neighbourhoods. Sub-Saharan Africa shows a rather more pessimistic picture in the past and future trends in animal agriculture. Suggestions are made for discussion on possibilities to introduce successful I&R (Identification and Recording) systems to the highly diverse livestock farming situations in the various regions and countries.

Keywords: *farming systems, trends, policies, institutions, animal recording*

Introduction

In the preparatory concept note for this seminar it was stated that the trends in livestock production which may have impact on the development and organization of animal recording can be summarised as follows:

- rapid increase of demand for animal products in developing and transition countries;

- increase in commercialization and intensification of animal production both in the rural family based systems as well as emergence of private sector industrial type of dairy, pig and poultry production in many CEE and CIS countries and peri-urban areas in the developing countries;
- withdrawal of the public sector from the production sector to limit itself to policy, legal, regulatory and other similar public functions;
- decentralization of decision making power on natural resource planning and management to local level stakeholders;
- major transitions and adjustments in the institutions involved in livestock and related skills development;
- favourable enabling environment to enhance private sector initiatives to develop decision support tools like animal recording at farm, community and national level;
- growing awareness regarding the sustainable use of animal and plant bio-diversity.

The purpose of this paper is to give the audience a broad idea of the projected future evolutions of livestock farming systems in various developing regions of the world. Particularly those livestock farming systems will be highlighted which could offer an opportunity to develop and apply animal identification and recording systems to better manage the livestock resources in developing countries. The main source of data and predictions used in this paper come from the recently (2001) published book by FAO and World Bank titled *Farming Systems and Poverty – Improving Farmers Livelihoods in a Changing World.* In the context of the overall farming systems evolution the book makes a sufficient analysis of the role and potential contributions of livestock under the external influencies listed above.

Farming systems concept

A farming system is defined as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and production constraints. For a farming system, similar development strategies and interventions (like animal recording) would be appropriate. Depending on the scale, a farming or livestock farming system can encompass from dozens to many millions of households. The farming systems approach is looking into the evolution of the systems both from bio-physical and socio-economic dimensions integrating multi-disciplinary analysis of production and its relationships to the key determinants of a farming system. The determinants of importance can be grouped:

- natural resource base and climate;
- science and technology; institutions, human capital and policies;
- trade liberalisation and market development;

The delineation of the major livestock farming systems provides a useful framework within which appropriate strategies and interventions can be determined. In this Seminar we focus to discuss where animal recording could be a feasible and appropriate intervention.

The classification criteria of the farming systems is usually based on:

- available natural resource base; and
- dominant pattern of farm activities and livelihoods.

Based on these criteria the FAO/WB report distinguishes eight broad categories of farming systems. For the purposes of this seminar the following seven systems (excluding coastal artisanal fishing system) in which also livestock play a major role and which could be useful for the dicussions here, namely:

- irrigated farming systems with a broad range of cash crop production integrated with livestock;
- rice-based farming systems;
- rainfed farming systems in humid areas of high resource potential with both small scale integrated crop and livestock or specialised crops and specialised livestock
- rainfed farming systems in steep and highland areas, which are usually mixed crop-livestock systems;
- rainfed farming systems in dry or cold low potential areas, with mixed crop-livestock and pastoral systems;
- dualistic (mixed large-scale commercial and small holder) farming systems, across a variety of ecologies and with diverse production patterns; and
- urban based farming systems typically focussed on livestock or horticultural production.

This criteria and broad grouping were then applied to six main world regions of the developing world in a pragmatic fashion with a view to draw conclusions with regard to future agricultural growth. The further analysis of the broad systems resulted in identification of 72 sub-systems. In many cases the sub-system resulted from differencies in criteria like for example from small-scale farms or commercial farms, or low altitude or high altitude areas. The names of the sub-systems were chosen to reflect the broad systems outlined above. For more in-depth analysis for prospects of growth and economic importance two to three sub-systems are chosen within each geographic region. Rapid and sustained growth in a major crop-livestock or livestock farming system could be expected to have a significant impact e.g through market linkages. Factors determining a system's apparent growth potential include:

- suitable natural resource endowments;
- favourable access to infrastructure and services, including markets; and
- feasibility of removing development constraints.

More recently, international agreements and the establishment of the World Trade Organisation (WTO) have significantly boosted trade liberalisation. As a result the reduction of impediments to international trade and investment, the process of trade liberalisation is generating changes in the structure of animal agriculture at all levels. This creates conditions which either could further marginalise traditional small holder systems but also give opportunities particularly to those systems which are (export / domestic) market driven and able to meet the challenges.

As the structural adjustment programmes have progressed, policy makers have increasingly shifted their attention to increase the efficiency of the service delivery through the restructuring of institutions. The shifts of many traditionally public sector roles to civil society and the private sector; the decentralisation of remaining government services and an increasing reduction of government investment in the provision of public services, have resulted from such adjustment. Animal recording services are among the functions now weakened by the diminishing public support and are one of the issues of our discussions in this seminar. The coping strategy involves better alignment of the non-government stakeholders who consider their participation carefully from a cost-benefit view.

In the next sections an attempt is made to identify in broad terms the potential livestock farming systems which would seem, in the authors opinion, to offer opportunities for a development of animal identification and recording systems in the various development regions.

Sub-Saharan Africa

In fifteen farming sub-systems the region has 219 million head of cattle, 194 million goats and 189 million sheep. From 1970 to the present time the cattle sheep and goat numbers grew moderately and also the productivity increases in milk and meat have been marginal (Table 1). Per capita animal food availability for human consumption hardly kept pace with the population increase.

For livestock potential the most important farming sub-systems are:

- maize mixed farming system
- highland perennial farming system
- large commercial and smallholder farming system
- urban based farming system
- pastoral farming systems

The maize mixed farming system is the most important food production system in East and Southern Africa extending across plateau and highland areas at altitudes of 800 to 1 500 metres, from Kenya, Uganda and Tanzania to Zambia, Malawi, Zimbabwe, South Africa, Swaziland and Lesotho. Cattle and small ruminants are numerous and important for household cash income. The prospects for livestock development and intensification are promising in areas of transportation and market access

Table 1. Trends in Livestock Populations and Output in Sub-Saharan Africa, 1970-2000.

Species	Million head in year 2000	Ave annual change 1970-2000 (%)
Cattle	219	1.5
Sheep	189	1.4
Goats	194	2.3
Pigs	19	3.2
Poultry	809	2.9
Product	Output 2000 (mill tons)	Ave annual change (%)
Total meat	8	2.0
Total milk	19	1.8
Total eggs	1	3.7
Cattle hides	0.5	1.7

Source: FAOSTAT.

but in more peripheral areas constrained by lack of services, infrastructure and by weakness of local authorities and communities to manage demanding services. These same observations certainly apply to livestock systems in the highland perennial farming systems and the pastoral systems.

Over the recent decade most of the countries in the Sub-Saharan Africa region have gone through Structural Adjustment Programmes which have lead to withdrawal of the public sector from many services and production, processing and marketing functions including animal production and health and milk and meat industries. The transition to private sector take-over, however, was mostly done without proper preparation and the build-up of private services has been slow. In much of the region, medium to large livestock farms (dairy, beef, mutton and poultry) have considerable scope for increasing productivity but will require more and improved financial, input supply and advisory services for which they will have to be able to meet the user charges. Animal performance recording would obviously have best chancies to be adopted in such systems.

For pastoralists and agro-pastoralists and the highland livestock keepers the main thrust will be to devise and implement disease monitoring and approved certification schemes for export of live animals and animal products. Particularly, the animal identification part of the I&R system and associated sanitary control are becoming very important for many countries of the region traditionally involved in export of live animals and meat in the international markets. Traditional preferential access of the ex-European colonies to the EU meat market is threatened under increasing competition from other regions and the live animal trade to

the Arabian peninsula countries is constrained by non-compliance with sanitary requirements. The members of the Southern Africa Development Community (SADC) have already made a commitment to plan and implement ID systems and in that context FAO has been invited to give technical assistance to Malawi to design a national framework for a phased implementation such a system.

Middle East and North Africa

The Middle East and North Africa region comprises 14 low and middle-income countries or territories streching from Iran to Morocco. Human settlement patterns vary but populations are increasingly in cities or larger villages in the rural areas. The region contains a significant number of pastoralists who move seasonally between low and high altitudes and between wetter zones and the dry steppe. There are eight major farming sub-systems of which important for livestock growth potential are irrigated farming systems (large and small-scale), rainfed mixed, pastoral and urban based systems.

The region is very important in sheep and goat production having a population of 197 million head, accounting for one seventh of the total population in the developing countries (Table 2). They are kept in a variety of production systems, which include:

- extensive pastoral systems;
- seasonal exploitation of crop residues in arable areas, and
- feedlots in and around major urban centres.

In recent times poultry numbers (900 million in 2000) have increased very rapidly at a rate of almost 6 percent per annum, nearly double that for the rest of the developing world.

Table 2. Trends in Livestock Populations and Output in Middle East and North Africa, 1970-2000.

Species	Million head in year 2000	Ave annual change 1970-2000 (%)
Cattle	21	0.8
Sheep	143	1.6
Goats	54	1.5
Camels	1	0.3
Poultry	905	5.8
Product	Output 2000 (mill tons)	Ave annual change (%)
Total meat	6	4.5
Total milk	17	3.4
Total eggs	2	5.4

Source: FAOSTAT.

Cattle and buffalo numbers have increased at moderate rate at 0.8 percent per annum and this rate is forecasted to continue although the region is not best suited to large ruminant production. In many countries large ruminant systems are highly polarised; very few large production units dominate the industry limiting the opportunity of the small-scale producers to compete in the market. This fact also explains that the productivity improvements in meat and milk output have remained at high level.

Trade liberalisation has favoured the large producers in the region and many smaller operators have moved out from business. The traditionally important artisanal animal product processing and marketing is closely linked with the smallholder production and there are minimal examples of modernisation of the small-scle milk and meat industries.

Public policies and investments in public goods have had a strong urban bias for many decades. Many public institutions are extremely centralised and development policies have favoured cheap food for urban population. National livestock policies have tended to aggravate the overstocking in pastoral systems and investment in industral animal production, through the encouragement of importation of cheap feed grain and the lack of regulation of animal numbers. These policies have also undermined the strength of traditional institutions and the systems of range management. For the same reasons innovation and diversification in livestock systems have been stifled and the top-down extension systems have left little scope for farmer driven initiatives and partnerships. Human capital hardly is a limiting factor but the system of extension, training and market information is not easily available to rural farmers.

Animal recording programmes are (or have been) operational in some of the countries in the region (Egypt, Tunisia, Jordan, Lebanon) and our colleagues from these countries can enlighten us on the experiencies during the discussions. In FAO's view the opportunities to make use of animal recording are in principle good in the large commercial livestock farms and high-tech applications can be applied in such conditions. The biggest constraint for institutional animal recording systems has been the difficulty to see what benefit a member could expect from participation. For instance a national progeny testing system of young AI bulls is lacking and semen is imported. At times even importation of bred heifers is subsidised for herd replacements. In many cases large commercial herds apply herd management software available from the market and use it efficiently for herd production monitoring and management of reproduction, health, and feed rationing.

South Asia

South Asia is comprised of eight countries and contains a human population of 1 344 million – nearly 1 000 million of them rural. The combination of high population and limited land (514 million ha) has resulted in severe pressure on natural resources. In the region eleven farming sub-systems are identified and livestock is important in most of them. Volume-wise and for the purposes of this analysis the most important ones are the:

- rice farming system;
- rice-wheat farming system;
- rainfed mixed farming system
- highland mixed farming system, and
- urban based farming system.

The overall livestock development pattern is very similar in the four rural farming systems. For meat, milk and eggs output has grown more rapidly than livestock populations, indicating that production efficiency has improved in the recent decades (Table 3).

Buffalo and cattle numbers have increased by a modest average of less than one percent per annum but milk production has grown by over four percent. With increased incomes also the demand for meats (poultry in particular) and eggs is expected to continue to grow significantly. The continued intensification and diversification of the farming systems is benefitting particularly dairy development which has become an engine of growth and income generation for the rural smallholder systems in South Asia. The increasing level of mechanisation reduces the number of draft oxen and results in a shift towards more dairy. Because of the increased availability of feed grains, by-products and crop residues family

Table 3. Trends in Livestock Populations and Output in South Asia, 1970-2000.

Species	Million head in year 2000	Ave annual change 1970-2000 (%)
Buffalo	122	1.9
Cattle	277	0.6
Small ruminants	321	2.1
Poultry	742	3.8
Product	**Output 2000 (mill tons)**	**Ave annual change (%)**
Total meat	8	3.2
Total milk	105	4.2
Total wool	1	0.9
Total eggs	2	6.2

Source: FAOSTAT.

scale dairy operations are expected to grow and intensify. In the proximity of the major urban markets the systems will also expand into specialised large-scale industrial/semi-industrial dairy and poultry enterprises.

Decentralisation of governance is expected to bring decision making closer to the farmer and the importance of farmers' organisations is expected to grow in the future. Private commercial sector together with farmers' organisations will play a bigger role in experimentation, advisory and market services. The NDDP in India and Milk Vita in Bangladesh are well known and strongly institutionalised integrated dairy schemes in the region and there are others, too. Such schemes can be instrumental for introduction of milk recording as a further service in support of breeding and management improvement programmes. The shift to more commercial and knowledge intensive livestock farming systems will call for improved flow of information to farmers, support services and the processing industry built on private-public partnerships. Our colleagues from the South Asia region certainly will go into more detail to propose the conditions in which milk recording could be succesfully integrated into the prevailing patterns of livestock faming systems development.

East Asia and Pacific

More than 60 percent of the region's 1.8 billion people are directly involved with agriculture. Most people are in two countries China (1.28 billion) and Indonesia (205 million). Out of the eleven identified farming sub-systems the most important ones are:

- lowland rice farming system;
- upland intensive mixed
- temperate mixed;
- pastoral, and;
- urban based systems.

The basic features and trends are similar to those in South Asia, namely rapid urbanisation, reduced and fragmented agricultural land, increasing pressure on natural resources and smallholder based agriculture, although semi-commercial and industrial production systems will increase over the coming decades. Most of the past growth in livestock production has been driven by the rapid expansion of the livestock sector in China. Numbers of pigs and poultry in the region have increased at high annual rates over the last decades and reached over 500 and 6 000 million head respectively (Table 4)

At present more than 50 percent of pigs and 36 percent of poultry of the world are found in the region. In the same period the international breeds have nearly totally replaced the once rich indigenous pig and poultry populations in China. This also explains the high average annual growth in productivity of meat and eggs. High annual growth has occurred also in milk production resulting mainly from the Holsteinisation of the specialised and family dairy herds, particularly in China.

Table 4. Trends in Livestock Populations and Output in East Asia and Pacific, 1970-2000.

Species	Million head in year 2000	Ave annual change 1970-2000 (%)
Cattle	38	1.9
Buffalo	152	0.3
Small ruminants	338	2.8
Pigs	501	3.0
Poultry	6 073	5.6
Product	**Output 2000 (mill tons)**	**Annual change 1970-2000 (%)**
Total meat	74	6.9
Total milk	16	6.1
Total wool	0.3	2.8
Total eggs	26	7.7

Source: FAOSTAT.

Growing urban markets and higher per capita incomes will maintain the increasing demand for animal products in the years to come. Urban and peri-urban agriculture is expected to expand and intensify with increasing demand for fruits and vegetables and meat and dairy products.

Regarding the future prospects for the introduction and adoption of animal recording systems in the region it would seem that it could be best associated with intensive animal production systems driven by the strong agro-industrialisation and urban demand. Maybe some of the participants here could tell us what might be the institutional form(s) to implement such programmes successfully. Livestock is also an integral part of the major rural farming systems in the region, but it largely remains extensive and it is not likely that animal recording could be there a priority service in the near future.

Latin America and Caribbean

In contrast with the previously commented regions, Latin America has low human population density of 0.25 persons per ha, combined with an urbanisation rate of 75 percent. It is also endowed with a wide range of favourable ecologies for agriculture and livestock. Pressure on natural resources by agriculture is generally moderate. Out of the sixteen farming sub-systems livestock is important in:

- intensive mixed farming systems;
- extensive mixed (Cerrados & Llanos) farming systems;
- cereal-livestock (Campos) farming systems;
- intensive highland mixed farming systems;
- temperate mixed (Pampas farming systems);
- urban based farming.

The 356 million cattle within the region constitute 26 percent of the developing world total and have increased by 1.6 percent per annum in the last three decade (Table 5).

Table 5. Trends in Livestock Populations and Output in Latin America and Caribbean, 1970-2000.

Species	Million head in year 2000	Ave annual change 1970-2000 (%)
Cattle	356	1.6
Small ruminants	119	-0.8
Pigs	75	0.6
Poultry	2 396	4.9
Product	Output 2000 (mill tons)	Ave annual change (%)
Total meat	31	3.5
Total milk	60	2.9
Total wool	0.2	-2.0
Total eggs	5.0	4.3

Source: FAOSTAT.

In contrast, the growth rate in other species except chicken has been slower or even negative. The cattle population is forecast to grow at 0.9 percent per annum. The increase in livestock productivity is also modest compared to many other regions most likely because the abundance in land and feed resources is not forcing intensification of production systems.

Latin America is, however, the only developing region with net positive livestock trade (874 000 tons per annum) and livestock (meat) exports are expected to triple by 2030, in contrast to other developing regions. Current net imports of 6.3 million tons of dairy products are expected to grow in line with the future growth of human population. Another major past trend in the region has been the political decentralisation closely linked with the process of structural adjustment. This has been used to shed fiscal responsibilities to local and regional levels of government. This has not always been a smooth process as the central level has resisted to relinquish power.

Being an important meat exporting region, it seems that the animal identification part of the I&R system and associated sanitary control will be very important for those livestock farming systems of the region traditionally involved in export of meat in the international markets. Increasingly demanding international trade requirements will concern Argentina, Uruguay, Brazil and Chile which are the major meat exporters. Eventually national ID programmes would offer the opportunity for future

extension into more comprehensive meat performance recording systems. Several countries of the region have recently approached FAO to help design ID systems through FAO's Technical Cooperation Programme. Chile will be the first country where such assistance will be provided. In peri-urban areas highly specialised industrial systems of dairy, pigs and poultry will dominate, providing ideal conditions for making use of animal recording for several objectives. It remains to be determined whether the conditions are given for sharing the objectives and costs fairly between the private and public sector. Maybe our Latin-American colleagues can offer useful guidance.

Conclusions

From the region-wide review the following conclusions could be drawn for further discussion:

1. *In the Near East and North Africa, South Asia and East Asia regions* the rapid increase in the domestic urban demand for animal products is particularly prominent which has lead to rapid intensification, commercialisation and improved animal productivity. The geographical distribution of these developments is, however, uneven also at country level which would suggest that rather localised than nationwide animal recording systems could be feasible. The real challenge is to reach institutional agreements between the private stakeholders (farmers, their societies, and milk or meat industry) and the public sector (government, research, extension) to share the objectives and costs of recording schemes. Otherwise individual herd management recording systems might become dominating over collective recording systems in industrialised large-size farms.
2. *In the Sub-Saharan Africa region* the growth and output of the animal industry, in general terms, is barely keeping pace with the human population growth. Real productivity improvements are not evident at the regional level and the urban demand remains too weak to provide a sufficient incentive to livestock farmers. Locations for introduction of animal / milk recording programmes need therefore to be selected carefully so as to focus on situations which are an exception from the overall regional pattern, in areas like milksheds of the major cities. In some countries there are, however, pastoralist and agro-pastoralist systems which traditionally supply animals for meat or live animal export. For those countries and systems the animal identification part of the I&R system associated with sanitary control is becoming very important (ref SADC) .
3. *In Latin America and the Caribbean region* a highly polarised situation can be predicted to continue; the major rural and peripheral livestock systems producing and fattening animals for the export oriented meat industry (beef / mutton) and the intensive peri-urban systems supplying milk, eggs and pork for domestic urban consumers. It could be expected that the new WTO certification requirements for the origin and health of the internationally traded animal products will accelerate the adoption of animal ID systems in many countries of the region. A

more challenging task will be the introduction and adoption of performance recording systems to complement the export oriented animal production systems or to support the commercial peri-urban intensive dairy production systems.

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Implications of livestock development trends on recording systems and use of animal genetic resources in Eastern European countries (CEEC) and Commonwealth of Independent States (CIS)

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Summary

This paper tackles selected issues and gives an overview of economic development and the impact on the livestock sector in Central and Eastern European countries (CEEC) and Commonwealth of Independent States (CIS). As the livestock sector cannot be independent from the economic and social environment, nor from development of agriculture, an attempt has been made to append the role of the livestock sector in this context. Central and Eastern European countries (CEEC) in transition have demonstrated a capacity to adapt rapid changes in production systems in the face of new challenges. The regions have faced many political and economic changes within the past ten years since socialism collapsed in the early nineties. Some countries have succeeded to move ahead fast with the liberalization of their economies and others have taken a moderate pace in the transition into market economy. Balkan as well as Caucasian and Central Asian countries are still depressed by the instability of political and economical changes and emergencies caused by conflicts and war.

The livestock sector has diverse roles throughout transition countries. Furthermore, livestock has a diverse role within one country. Livestock and agriculture are important to poor CEEC and CIS and the role of the livestock sector is in transition and has an impact on the level of livestock improvement services. The state of the livestock development services and animal genetic resources is strongly related to the level of economic development of the countries in transition.

Livestock development prospects depend on the appearance of market forces, interaction between government and farmers' organizations and the experience and improvement of managerial skills in public and private sectors.

Transition period

A dozen years have elapsed since the world witnessed the euphoria greeting the fall of the Berlin wall. At the beginning of the new millennium, a profound divide lies between Central and Eastern Europe (CEE) and the Commonwealth of Independent Sates (CIS). Transition countries are not a homogenous group in any economic, political, social or geographical terms. Altogether 27 countries in transition belong to the CEE and CIS regions:

The most commonly used grouping of countries is as follows:

- Central and Eastern European countries (CEEC):
  - *Central Europe*: Czech Republic, Hungary, Poland, Slovakia and Slovenia.
  - *South-European Countries*: Albania, Bulgaria, Croatia, Romania, The Former Yugoslav Republic of Macedonia (FYROM) and Yugoslavia.
  - *Baltic Countries*: Estonia, Latvia and Lithuania.
- Commonwealth of Independent States (CIS):
  - *Western part of the former Soviet Union*: Belarus, Moldova, Russia and Ukraine.
  - *Caucasus*: Armenia, Azerbaijan and Georgia.
  - *Central Asia*: Kazakhstan, Kyrgistan, Tajikistan, Turkmenistan and Uzbekistan.

Although transition economies have shared many of the failures of the central planning model, there are significant differences between them. These differences concern the inherited ownership structure, geographical orientation, resources, timing of reforms and historical, political, administrative and cultural legacies. Despite these differences and the differences in strategy all governments have pursued the same broad goals of policy: economic growth and efficiency, stability, security and sustainability.

For many CIS, but also for CEEC, the structure of the economy has changed markedly since the early nineties and the share in the GDP of industry, which was the most important sector during the Socialist era,

declined. Though the output agriculture decreased to 40 percent in CEEC and CIS, the share of agriculture in GDP increased significantly: in Albania and Armenia, the share of agriculture in national GDP has doubled. In Central European countries as well as Baltic countries, the agricultural output remained stable, with the exception of Estonia, where the share of agriculture has reduced by more than 50 percent. Generally, in many countries agriculture did not decline as steeply as industry, largely thanks to the implementation of a sustained programme of land reform early in the transition. Livestock production makes up a significant portion of national wealth in the countries where agriculture is important. The role of livestock production in the economic structure of the country is tangibly highest in Armenia, constituting 11.6 percent of the GDP in 1999.

Privatization started in most countries in 1991-1992 and prices were liberalized. The markets in the former Soviet Union were cut off together with supplies of a number of basic commodities (cheap energy, cereals and industrial raw materials). The monetary reform together with the market economy reform has changed the supply/demand balances which were affected by the closer alignment between domestic prices and prices for imported commodities. At the same time many governments cut off massive subsidies for agriculture and signed free trade agreements. The restructuring also entails a dramatically reduced role of government in agricultural production, processing and marketing. The political liberalization in CEE is subsequent to the globalization of trade and markets.

According to the FAOSTAT, the total population of the CEEC and CIS was 478 million in 1999, of which 154 million is rural population (32 percent). Agriculture is still the largest and/or very important employer in the majority of CEEC and CIS. In proportion to total employment, agriculture is more important than in the EU. In Albania, Armenia as well as in Romania the share of agricultural employment in total employment is more than 35 percent; in Poland the figure is near 25 percent, at the same time in those countries small private farms account for more than 70 percent of all farmland.

Transition has clearly had an impact on social wellbeing. Poverty increased sharply during the transition period. According to the WB (1999) there was in 1987, one million poor people (i.e. consume less than US$1 per day per capita) in CEEC and CIS. By 1998 the number had increased 24 times. The population below the poverty line is still increasing in CEEC and CIS: the population living on less than US$1 per day has increased from 1.5 percent a day (in 1990) to 5.1 percent in 1998. The UN Human Development report 2001 shows, that life quality is qualified as high in only eight countries, whereas the same number of countries shows an increasing trend. At the same time, the majority of the countries shows a reduced average life quality and increased poverty.

The population below the income poverty line is between 21-50 percent in seven countries of the region and in ten countries 51-66 percent of the population lives below the income poverty line of US$4 per day.

The search for explanations of varied economic outcomes, causes, differences in magnitude, variations and sustainability focus on the characteristics of countries at the beginning of transition, the shocks emanating from the breakdown of the central planning system, the dissolution of the Soviet Union, wars and civil conflicts, and the policies to facilitate transition. Some countries have succeeded in moving ahead fast with the liberalization of their economies and others have taken a moderate pace in the transition into market economy. According to the economic outcome the countries in the region can be divided into two subgroups:

1) Fast reformers of market economy: countries in Central Europe and the Baltics have demonstrated a capacity to adapt rapid changes and have succeeded to move fast ahead with the liberalization of their economies.
2) The second group has taken a moderate pace in the transition into the market economy (CIS, South Eastern European countries). Some countries are trapped in the situation of partial reforms and are "in a no man's land" between plan and market. Balkan as well as Caucasian and Central Asian countries are still depressed by instability of political and economical changes and emergencies caused by conflicts and war (slow reformers).

Changes in farming systems and in support services

The transition process has led to profound structural changes in the agricultural sector in CEEC and CIS. Political reforms, economic and demographic pressures caused changes in farming systems. While globally, these pressures are generally for intensification of systems, the CIS and CEEC are exceptions to this. At a very broad level, this can be quantified by comparing the size of farms and number of animals on one hand and volume of production on the other.

With a few exceptions (Poland, former Yugoslavia), in most countries the public policy after World War II was to replace the family scale farm by socialized large-scale farms. Since the late 1980s the new political power in CEEC aimed at agricultural reform to create conditions for rapid emergence of the private and market-based agricultural structure. Within the agrarian reform the land and property reforms are affected by different speed and still continue to be so today in all countries. The quick formation of new farms was supported by the political and economic situation, while the Czech Republic, Hungary and the Slovak Republic maintained the majority of the large state properties undivided and restructured and privatized them to the new owners.

The privatization process has created a lot of problems where the restitution of land resulted in small and fragmented farms. Reduction of the average farm sizes, fragmented farm structures and decreased production and productivity are the common features of the structural changes in CEEC and CIS. Both the transitional process and the choice of ultimate farm structure, present major problems in CEEC. Following the dissolution of the State and Cooperative farms, the CEEC are in the process of establishing the livestock sector, which would be competitive in domestic and global markets. However, as a result of the agricultural reform and land restitution in many CEEC, the small-scale farming was re-established, which renders the collection of marketable surplus livestock products and makes the provision of cost–effective livestock support services difficult.

With prices now determined by the market, farmers are faced with soaring real costs of inputs and falling output costs (alternative private market channels are slow to develop in competition to the state channels). In early transition, largely demonetized subsistence agriculture relied heavily on bartering with the state (or semi-state) organizations for products that were otherwise unavailable. The processing industry was largely inefficient and oversized for the fast-reduced volumes. Transport and logistic systems designed for large farms became obsolete or too expensive to be maintained.

With the economic transformation so came changes in the urban consumer market. Widespread poverty and declining household incomes led to a fall in domestic demand for products (especially meat) of the livestock subsector. With the rapid rise of subsistence agriculture in the countryside, more milk and dairy products were being produced and consumed on farm. Subsistence farming is dominant in South-eastern European countries as well as in Caucasian countries. Although the dimensions of the livestock sector have decreased significantly (up to 40-60 percent), livestock is still very important in rural livelihoods where this is the major source of income for many rural families. Whilst during the socialist era animal production was merely planned to produce food as well as raw materials for industry, currently livestock contributes, more progressively, to the function of reducing risk, enhancing income and the livelihood support of the rural people, who are in many cases very poor

Countries more advanced in their recovery have managed to build up private enterprises, which overtook the state sector. The bulk of the livestock produce is processed and value added products are sold on the market. These countries have been more successful in increasing their exports and reorienting them to the industrial countries.

Current farming systems in CEE are described area-wide as large, specialized, intensive (high input) production systems greatly mixed with smallholder (low-input/low-output) farming whereas this farming patterns varies greatly from country to country.

Farms in a transition economy can be distinguished by history: are they new, restructured or old? They can also be distinguished by economic performance: are they productive? Furthermore, history and performance are related. New private farms were expected to be more productive than restructured collective and state farms. The role of history progressively weakens: years of transition has proven, that countries where small farming is prevailing, be it 'old' like in Poland, or 'new' like in Bulgaria, will face more challenges, than countries where state farms remained undivided and restructured as agricultural enterprises.

The decade of restructuring has not yet demonstrated, what would most sustain production systems in the future and it is not quite obvious which farming systems are not on a sustainable track.

Different farming systems face a number of challenges in the future:
Challenges to large-scale industrial farms:
- dependence on inefficient processing and marketing;
- quality requirements: consumer demand or a political decision?
- investment needs;
- ownership structure, incomplete privatization;
- labour intensive technology;
- environment.

Challenges to small farms:
- economic sustainability, efficiency;
- missing support services;
- access to markets;
- inadequate technologies (in new small farms);
- investment needs;
- missing skills and tradition;
- missing services and relatively high prices;
- quality requirements.

Challenges to subsistence farms:
- limited perspective for livelihood;
- alternatives;
- access to information and education;
- participation of society;
- sustainable management of natural resources.

The EU accession countries will have an additional external challenge: the milk production quota imposed by the EU upon enlargement. The milk quota will effect the prospects of dairy farming all over the region and will increase the risk of amplifying the existing problems in agriculture and society.

In general CEEC and CIS farming systems are extensive, labour intensive and still largely less productive than in western countries, which hampers competitiveness in domestic markets (which are wide open to global trade) and reduce trade prospects in global export markets. Although recent studies show a slow increase in farm size and gradual consolidation of resources, the differences in productivity end economic performance are disappearing slowly. Problems related to the fragmented farm structure demands resolution at political level and the majority of the governments in CEEC advocate sustainable intensification of farming as successful transition into a market economy commands increased efficiency and hereby, sustained government attention and support to the animal recording services plays a very important role.

Livestock development services

Together with agricultural re-structuring and privatization has also come institutional change, reorganization of ministries, academic institutions and service organizations. Governments applied varied strategies to advance reforms. The striking diversity in challenges and circumstances has not proceeded far in transition, in particular, countries in the CIS and South-eastern Europe (SEE). While Central European countries have managed to maintain and / or re-establish the most important services to new livestock farmers, in CIS and SEE, many formerly state provided services are no longer available, or are inadequately prepared to serve the new farmers. Therefore, this part of the paper presents cases, where these countries can hopefully learn from successful reforms in Central Europe and the Baltics.

Although the general trend was towards privatization, there was hardly any initiative and very little interest and initiative from farmers to take over operational management. The establishment of farmers' organizations was encouraged and strongly supported by the government and international technical assistance projects.

There are no significant differences between countries with traditional farms (Hungary, Slovakia and Poland) and countries with new private farms, in all cases reorganization of the animal breeding services was operated by state institutions.

Central European governments and Baltic countries postponed the pain of liquidating and restructuring the old service structure while the cushion provided to the newly established breeders' associations, intended to take-over the state provided services: herd book, selection, artificial

insemination (AI), milk recording (MR), data processing (DP) and genetic evaluation. On one hand the State gave more responsibilities to the private sector, on the other hand, while heavily subsidising the activities.

Looking back, this decision has been important. Countries had bad experiences by imposing full privatization of livestock development services (like in western countries) in the early stages of transition. However, this period was still one of the extreme hardships for the farmers and in all such cases the new organizations failed to build up the service operations. Often those efforts were initiated by development projects and were only maintained until the project was finished.

The countries with strong involvement in the public sector in animal recording have succeeded to win time for learning the market economy principles and gaining experience. Generally in those countries farmers are responding better to external and internal demands in the business environment.

Irrespective of the ownership of a service organization (public or private), there are five main areas important for sustainable service:

1. Strategic and operational management (strategic planning, operational management, quality control, risk management, technological change).
2. Financial management (cost recovery, prising of services, budgeting and cost control).
3. Customer service and service development (customer needs, customer orientation, service development technology training).
4. Legal and policy frameworks (modifying legal and policy frameworks).
5. Administrative effectiveness (coordinating activities with other organizations, decentralization, interaction).

CEEC demonstrate a wide range of options to adapt those needs by sharing the tasks between the public and private sector. In early transition strategic and operational management was clearly imposed by the government and only after some time were farmers' organizations able to take over a part of the strategic and operational management tasks, while risk management and technological change is still funded by the government in most cases. Here the state intervened in many countries: institutions and organizations are important, but so are policies, which need to encourage the creation of new organizations which are able to compete in the market place without seeking special favours from the state.

Financial management principles were an entirely new area of all the people in post-socialist countries. People who worked in budgetary institutions had never learned financial management. While small enterprises, farmers among them, learned the cost recovery approaches very fast,

Estonian Case

Three cattle breeding associations were established in 1992. In 1994 two larger organizations privatized the AI centres, recruited former government staff and officially took over the HB from the state. The main income generated from AI service: state subsidy constituted ca 10-30 percent of the annual budget. Associations faced difficult times: constantly reducing cow population, less use of AI, higher transaction costs because of small farms: more members, less services, investment needs and increased competition at the domestic AI market. As a result the economic situation of new organizations was weakening further.

Although the Government of Estonia suggested a merge of organizations seven years ago, the organizations were enjoying their autonomy and farmers were reluctant to realize the need to consolidate resources until the economic situation became critical. Finally, the decision to merge three organizations into one took place in 2002. The main responsibilities of the newly reformed breeding association was to cover all cattle breeds: herd book registration, bull testing, marketing of semen and breeding stock, distribution of semen, insemination registration, advisory and extension. In the future perspective; one strong organization serves farmers better than several weak ones.

The new organization is expected to privatize the state owned Animal Recording Centre (milk recording, milk quality control, data processing services, and genetic evaluation) and it is only a matter of time until the organization become economically stable. The State is not involved in the operational management of the organization and support is mainly targeted to the development and technology change. Estonia's experience shows that timing of reforms (shifting the activity from public institution to the private organization) had to be postponed until organizations began functioning as a business association and the role of the Government was important in sustaining the service meanwhile.

the financial management of organizations and activity was emerged by monetary reforms and uncontrollable inflation. Regardless of whether the livestock development agency is public or private, most of them have learned to apply the self-financing approach and cost recovery principles.

Self-financing of the MR organization is problematic in the situation were farms are very small and / or participation in MR or AI service very low (transaction costs are high) and / or the total cattle population is reducing,

which makes the overhead costs per service unit increasingly higher. The situation is very critical especially for the MR organization, which has a high fixed cost component.

According to an ICAR survey, farmers pay an increasing part of the cost of the milk recording in all countries. In some of the countries (Lithuania and Slovakia) the MR service was fully paid by the State until recently and there are plans to relinquish this practice. Only a few of the MR organizations in CEE have the capacity to manage the organization as a business. For instance the Hungarian MR organization has operated as a limited liability organization for more than 10 years, all shares are owned by the State. Farmers pay close to 100 percent of the operational cost of the MR service in the Czech Republic, Estonia and Hungary. In Estonia only B recording is used.

The changes in the farming structure are still continuously deflating the financial situation of the newly established organizations. Trends in the CEE farming systems progress against the tendency in the western countries and do not favour meeting the challenge of implementing cost recovery principles in milk recording. Organizations serve an increasing number of farms of very diverse sizes and different needs. At the same time the average herd size is still declining and so is the total cow population therefore cost per cow and per farm is continuously raising.

When seeking good examples for *Customer service and service development*, we should not observe countries, where the service is still fully paid by the government. The best cases of customer (farmer) orientation can be

Hungarian Case

Hungary has been a star pupil in the transition process applying the cost recovery principles in the early stage of transition: prising all services. Budgeting and cost control was imposed by the business operation (Ltd). Continuous investment into technical developments was aiming at improvement of services. Although the Hungarian average herd size in MR is one of the largest in the world, the financing of recording is emerged by constantly reducing the total cow population and especially by decreasing the average herd size, while the number of herds in the MR service is increasing fast. In this situation sustained cost recovery is a real challenge as well as maintenance of the quality of service without being directly sponsored. The A4 recording is increasingly replaced by other methods, which are remarkably cheaper. Hungary is seeking a solution by providing AT, B and C method of MR.

found in countries where there is high or fast growing participation in MR services. Service and technology development and training of farmers and extension people are becoming a daily practice. In most of the countries the participation in MR has risen, which is a sign of the desirable service. Bulgaria has about 10 percent of cows in milk recording, Croatia 38 percent, the Czech Republic 95 percent, Estonia 72 percent, Hungary 73 percent, Latvia 37 percent, Lithuania 24 percent, Slovakia 75 percent, Slovenia 45 percent, Poland 11 percent and Russia 18 percent.

The MR organizations gradually learned what does servicing mean: the service should support the farmers' decision-making process. Generally a lot of data on animals was recorded and analysed for administrative purposes in the socialist era and not many decisions were taken at farm level. Successful reorganization of milk recording services during transition is dependent on how fast the MR organization became service-oriented and functional for the farmers' decisions.

The "classical" milk recording (milk quantity and fat/protein measurement) is not the only information service provided to farmers. Milk recording organizations are expanding the number of services provided for farmers and seeking new customers: AI and HB organizations, veterinary service, dairy factories, and public sector. Some countries are fast moving ahead with innovative approaches in providing customers the real-time information: more than 200 farms in Estonia have daily access to their data via Internet and SMS message regarding the laboratory test of SSC which is becoming more popular.

The public sector is ruling in the *legal and policy frameworks*. In early transition most of the countries were operating in a legal system of socialism. The first attempts made to legalize private enterprising as well as new state agencies was important. In most cases the national legislation was harmonized with EU legislation and the current Animal Breeding Law in force is probably the second or third law since the 1990s.

Administrative effectiveness became important in the countries where governments withdraw in providing operational support to new organizations. New sets of institutional linkages were to be established: for coordinating and integrating activities with other organizations. Here the government is playing a central facilitator role and the private sector is not ready to take over the management, organizations and institutional linkages.

Central European countries and the Baltics started reforms early and learned very soon, that reforms have to continue. In reforming the animal recording and breeding organizations the public sector is still a new player in CEEC and CIS.

The Government's support can be provided in two ways:
1. Maintenance (budget, direct subsidy)
2. Encouragement (incentive measures, targeted support).

Provision of public support in transition countries should be targeted and provide incentives for improvement and encouraging farmers' involvement. In livestock development services incentive measures are advisable in most cases.

The principles of the self-help organizations were introduced by western countries. By definition (H. Nygaard) a self-help organization is an organization that solves professional, organizational and commercial tasks for the livestock producer, possibly in cooperation with other organizations, but is mainly financed and managed by the livestock producers themselves. In principle each livestock producer pays for the services ordered from the self-help organization either directly or via membership fees. The main function of the membership fee is to contribute to secure the existence of the organization and its professional advice and services.

The self-help organizations in Europe have a history dating back 100 years and successful reformers in transition countries have gradually applied the self-help organization principles into their operations. Here it is important to notice, that development of the current animal recording and breeding structure in western countries took place in the situation of constantly growing markets and it is often forgotten that the government was playing an important role in reorganization and supporting the farmers' organizations.

Development needs in the countries where animal recording and animal breeding collapsed and where farmers do not have access to information and quality control services can be divided into two groups:
1. Technical (animal science and technology related).
2. Operational (establishment and management of an organization in the market economy).

The countries in an advanced stage of transition have proven that technical problems are easy to solve but management skills need to be upgraded.

The discussion regarding the optimal share of the roles of the private and public sectors in animal recording and breeding will continue. Government and governmental institutions will play an important role in the countries, which have to 'get started' and sustain recording and breeding activities.

One may pose a question if animal recording is needed at all. I do believe it is important as much as it has been important for the developed countries to contribute to improve productivity, thus increasing the economic importance and activity of farming, e.g. via cheaper food or a higher export income. So the State has a clear economic and political interest in supporting the general activities of the recording and breeding, especially in the countries where agriculture is the major part of economy and employment.

Impact on farm animal genetic resources

Animal genetic resources constitutes an important resource for efficient and sustainable livestock production. Thoroughly modified and adjusted to meet society's needs livestock genetic resources are the basic environmental input to animal production systems. The utilization of the genetic reservoir largely determines the type and level of animal production systems employed and in this respect CEEC and CIS have faced many challenges:

Production systems changed drastically. The transition time did not clarify the concept of sustainable farming systems in order to provide a basis for identifying and making operational separate sustainability issues related to farming systems. Technology driven development requires economic performance which undermines sustainability issues, the diversity of farm animal genetic resources is among them.

The present Status of Domestic Animal Diversity is well-monitored in CEEC but there is very limited information available about the situation in CIS. The animal breeding structure was somewhat different in CEEC and CIS than in western countries, but still many globally used breeds were introduced during socialism and many countries operated improvement programmes for native breeds. The economically developed CEEC could maintain and develop further the animal recording and genetic improvement services while in the majority of the CIS no programmes are operational any longer.

In the context of the sustainable breeding we are concerned about the extent of the effect of inbreeding.

Inbreeding is dependent on selection intensity of parents, reproduction efficiency (use of AI, MOET, cloning), reduced generation as parents, co-selection of parents and allowing mating between parents.

In this context we may assume that the erosion of genetic biodiversity is not threatening CIS until the fast economic development takes place. In CEE erosion should be slowed down by reduced intensity of selection programmes and limited use of AI, MOET.

However, drastic reduction in livestock numbers has been registered in all CEEC the livestock populations decreased by 50 percent. The reduction manifested also for breeding stocks and many small breeds disappeared, which has an impact on the diversity among breeds. Only a few genetic improvement programmes are operational, while genetic improvement is increasingly imported.

In order to assess the impact of transition to utilization of animal genetic resources in cattle populations, the FAO Subregional Office for Central and Eastern Europe, initiated a study in three countries of CEE: Estonia, Hungary and Slovakia. The key indicators of monitoring the change during 10 years of transition were:

- farms with cattle;
- breeding structure;
- inter-population gene flow;
- population size;
- monitoring and utilization of genetic diversity.

The results of the study are not completely summarized but some of the first conclusions can be made:

1. During 10 years of transition breed, the composition of milk producing cows has been changed in favour of HF cows in all three countries. HF population size increased by 175 percent in HR during the overall reduction of cattle numbers. In Estonia the Estonian red reduced by 75 percent while HF population reduced only 43 percent.
2. The population size of native breeds has been maintained by state subsidies.
3. Less breeds are actively used, only a few breed improvement programmess for smaller populations
4. Smaller active population size supports increasing reliance on foreign breeding programmes, less sires tested from national breeding programmes and AI uses imported bulls.

Looking for answers to the reasons of the erosion of diversity in cattle populations, we would like to better understand the farmers' decision-making process and failures in the management of the breeding programme as well as impact of the opening of the markets to the global trade and impact on economic developments.

Conclusions

- The livestock sector has diverse roles throughout the transition countries. Furthermore, a diverse role within one country. The role of the livestock sector is in transition.
- Livestock and agriculture is important in poor CEEC and CIS.

- The state of the livestock development services and animal genetic resources is strongly related to the level of the economic development of the countries in transition; development prospects depend on:
  - appearance of market forces
  - the interaction between government and farmers' organizations
  - improvement of managerial skills in public and private sectors.

International livestock development and animal recording systems. Some experiences from the World Bank

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Summary

International lending institutions such as the World Bank are supporting public sector investment in food safety and consumer protection. Tracing of animals and animal products is generally considered part of such programs. However, tracing systems are expensive and countries should try to consider the benefits and costs before initiating a national tracing/identification program, and make sure that such investments are backed by a sound livestock strategy and by an assessment of their effect on the poor. Developing countries tend to mimic the system in Europe or north America without giving sufficient thought to the difference in Government support and in livestock systems. Most developing countries and ex-Soviet countries have a large number of small-holders, and the transaction costs of reaching this dispersed livestock population, including a timely recording of changes, are very high and not affordable.

A review of projects and proposals to the World Bank show that the proposed programs are not always fully discussed in a national forum on priorities for the agricultural/livestock sector, and are not well thought through in terms of technical design (especially with respect to movement recording), financial sustainability, and responsible agency.

Sound planning and careful monitoring the costs and impact should be an essential part of these programs.

Keywords*: Animal identification, food safety, livestock economics, benefit-cost analysis, cost recovery, World Bank, poverty, monitoring.*

[1]The opinions expressed in this paper are those of the author and not necessarily of the World Bank and its affiliates. The useful comments from Cornelis de Haan are gratefully acknowledged.

Introduction

In view of the many challenges of international development, bridging the increasing gap between rich and poor, animal recording seems a minor issue. On the other hand it is widely believed that improved international trade may be an important factor in achieving a more equitable development that includes currently underdeveloped nations. Better coherence between trading partners and better guarantees (in transaction, in quality etc.), are expected to facilitate international trade in general and especially in agricultural and animal products where standardization of product quality and safety has been difficult.

Recent food scares such as those caused by bovine spongiform encephalopathy (BSE), and the western European foot and mouth disease (FMD) outbreak have further revived the interest in food safety. In particular there is increased interest in being able to trace farm products from "farm to fork". Over the past few years, tracing systems used to identify animals, monitor their movements, and trace animal products have evolved considerably, largely due to the requirement by large trading blocks (the EU in particular) to have all animals registered. Some of the World Bank borrowers have requested public sector support to establish or improve an animal recording system in their country and some pilot efforts were indeed financed in some countries in the Mediterranean region, Balkans and South America.

Currently, this standardization is driven by large trading blocks (EU, US, Japan), and developing countries need to be vigilant and aware of these new rules in international trade. They should also be aware that these harmonized standards are not always to their advantage, as they are expensive, require considerable administrative sophistication and may take a long time before full (internationally accepted) implementation. A number of studies have described methods and technologies used throughout the world at each stage in the food production chain, or their diversity. This presentation is not doing so, but presents a number of issues, examples and experiences that may guide policy makers in developing countries that are contemplating the adoption of individual animal registration systems.

The World Bank

Before discussing the topic of this meeting, it may be useful to explain a little about the World Bank and its role in development, as there appear many misconceptions about its role and mission. The World Bank is a development institute owned by countries that are its shareholders[2]. The interests of these shareholders are represented by a permanent board of directors and by regular ("annual") meetings. The World Bank's loans and other major interventions are approved by this executive board. The

[2]Extensive information about the World Bank, its mission and lending is available on its external web site http://worldbank.com

Box 1. The lending cycle

In general the World Bank assistance to borrowers begins with a jointly developed and agreed country assistance strategy (CAS). In many countries this may be complemented by a poverty and reduction (and growth) strategy, but the CAS more or less sets out the expected development of a member country, including constraints and opportunities. The CAS also identifies possible World Bank (and donor) assistance often over a medium term timeframe. This assistance program may consist of economic and other analytical work[1] as well as lending.

Lending

A lending program or other activity that is entered in the CAS and still requested by the Government will then need further planning and development. This planning part of the "lifecycle" of a Bank lending program, which is explained on the World Bank's Web site, may take between 1 to 4 years depending on the Government's capacity and the complexity of the proposed operation. The development of lending proposals is the responsibility of the borrowing Government. In cases where the capacity of such Governments is low, it can call upon outside assistance. Especially the Japanese and selected European governments have been generous in providing, untied, financial support to World Bank borrowers for project development. Once a project has been designed a World Bank team will evaluate ("appraise") the design and together with the Government come to a final product that is presented to the World Bank's Board of Directors.

day to day decision making is increasingly decentralized and made in the regional offices, and the Bank has offices in most of capitals of its borrower countries

The resources of the World Bank and its affiliates are generally obtained in the world's financial markets i.e. issuing bonds. The one exception is the International Development Association (IDA) which receives funding from richer countries to be lent out to very poor countries on concessional terms (currently the cut-off point qualifying for IDA is an per capita GDP of US$ 885). The Bank only lends to its members (i.e. governments) except for the International Finance Company (IFC) that also lends to - or

participates with equity in - private entities. With a few exceptions the Bank does not provide grants, and its lending is scrutinized for social, economic and environmental sustainability.

The current overall objective of the Bank's program is to reduce poverty. It does so by providing policy advice, lending and assisting governments to improve access to foreign investment.

Considerations in lending and appraisal

The World Bank only lends to governments i.e. the public sector. It is fully aware, however, that most economic development derives from private sector initiatives. As such it pays considerable attention to assure that its investments are improving the public sector function without discouraging private sector initiatives. The overall considerations in appraising a program or project include (i) its contribution to poverty reduction and development in general, (ii) its economic justification, (iii) a justification as a public sector investment, and (iv) whether it poses any unacceptable fiduciary or corporate risk either to the borrower or to the Bank[2].

In most developing countries the resources available to the government are insufficient to provide comprehensive quality services. In Africa this has been clear for sometime (Anteneh, 1984), in the FSU the issue is just emerging. As such, choices have to be made, and the Bank is sometimes seen as too inflexible about priority and sustainability needs of its investments.

On the other hand producers, under severe budget constraints of governments and developing agencies, are looking for other ways to ascertain delivery of services, and are sometimes surprised to find the alternatives, for example through private sector delivery, may not only feasible but even work better.

Livestock development

World Bank lending for livestock development has undergone a major change during the last decade. The overall trend is to move away from projects and investments that can be carried out by the private sector, and concentrate on removing impediments to private sector development and on those programs that support improved efficiency of the public sector. Consequently, earlier programs that financed state- or parastatal owned large-scale livestock production and processing (whether feed manufacturing or abattoirs) have largely been abandoned[3]. Animal breeding is among the activities considered as a private sector activity

[3]Such investments are now mainly supported through the IFC, or indirectly through non-targeted credit.

that is outside the direct realm of the state and consequently of financing by lending institutions such as the World Bank. Also, the previous trend of free standing livestock projects is changing towards livestock development components that are part of larger agricultural, rural or environmental or credit project. For example the current portfolio of the Eastern Europe Central Asia Region of the World Bank counts one free-standing livestock project, but at least a dozen projects (excluding rural finance loans) with a livestock component. Interestingly, the tighter control over credit in the Region's rural finance project seems to benefit livestock farmers; in many countries, close to half of the credit is devoted to livestock production and processing.

Currently the main challenges in international livestock development, as recently defined by selected World Bank staff (de Haan *et al*., 2001) are food security, environment, serving the poor, livestock and consumers and animal welfare. The main role of the World Bank includes ensuring an appropriate policy framework and access to knowledge, to resources (especially pastoral land), to financial services, and to services such as animal health and breeding. Ensuring access differs from providing access, the access can be also provided by the private sector but the state ensures equitable access and monitors the quality.

Access to markets is a major concern of producers. Unfortunately, the rules in the international market place are rarely providing for a level playing field, and developing countries' access may be limited. The reasons for the lack of a level playing field are economic (with subsidies and tariff protection for agricultural production in Europe, North America and Japan), and maybe related to slightly biased standards of quality and food safety[4]. The rules governing this are becoming so complex and costly that it excludes all but the most courageous third world producers.

Considerations for lending for investment in animal registration

Despite this complexity some countries feel that they have to join the momentum of food safety and greater control over livestock movement and product quality initiated in Europe in the late eighties and now followed by north America and other exporting countries. Some developing countries that are neighboring the EU or are exporting animal products to the EU, US or Japan are contemplating to adopt these "world market" standards. Moreover food safety is heavily promoted by international organizations such as the WTO and FAO[5]. One spin-off of

[4]For example, rules on food safety are aimed to protect consumers but a common spillover, i.e. the protection of local markets, can sometimes be the driving force.
[5]And not always for altruistic reasons, as the bureaucracies of these organizations may need these initiatives for survival.

the food safety movement is the desire to improve the tracing[6] of animals and animal products and EU rules now mandate to do this through individual animal registration and comprehensive food labeling.

Box 2. Stratification between public and private investment

Considerable literature exist about the issue of private versus public sector roles in investments and services, and the opinions vary and are still changing. With respect to livestock see Umali *et al*. (1992), Leonard (1993) and Gross (1994).

In general, public sector input is required for those activities where markets fail, where the benefits can not be appropriated to individual beneficiaries but are available to the whole community (i.e. public goods, such as food inspection and quarantine), where quality is not transparent (quality control of drugs and vaccines), or in situations where there are significant externalities ("spill over", i.e. compulsory interventions such as vaccination campaigns). The public sector also plays an important role to ensure fair and equal treatment of all aspects of society, especially the poor and disadvantaged. However, public investment should not lead to unfair competition with, or undercut, the private initiatives.

Private goods on the other hand are typical goods and services where the beneficiary is identifiable, understands the benefits and may be willing to pay or contribute in another way to obtain these goods or services. Typical private goods in the livestock sector are the purchase of feed and fodder, the purchase of breeding services (where farmers pay fully for either natural breeding or for semen and AI services), or the purchase of clinical veterinary services. The balance between private and public varies, and is largely based on the economic history of the country. For example, there is a clear dominance of the public sector in some countries such as Cuba and in many eastern European and former Soviet Union (FSU) countries. There is a sound belief in the benefits of the private sector in Anglo-Saxon countries and in capitalist countries in general. But even, in the latter group, there are clear differences of opinion. In the end, however, the private-public stratification, whether or not based on economic theory, is a political decision.

[6]Tracing animal movement is nearly as old as animal marketing (examples are branding of animals in the American West, in colonial Nigeria or in 16th century UK. See also Landais, 2001).

Affordability: Based on interactions with various borrowers, the main under-estimated constraint in food safety and animal recording components is affordability[7]. Animal recording in its current format is a concept and implement of western governments. Generally these are countries where farmers are heavily subsidized (and, also, where registration is a requirement for getting subsidies), where herd resistance to disease has diminished (compare for example the substantial impact of the British FMD outbreak in 2000 with a similar, but globally barely noticed outbreak in central Asia) and where fast food consumption makes consumers more vulnerable to multi-consumer food poisoning.

Farmer subsidization also increased the size of farms, and thereby reduce the transaction costs of providing farm services. Still, even in these countries there is considerable opposition to charge the full cost to the industry. After all, the public-private stratification may economically be correct – but not always politically acceptable.

For a wider debate about the affordability of food safety regulation see Antle (1999) who found that food safety economics are complicated by the difficulty to determine the costs, as the value of "food safety" itself is difficult to measure. Indeed, the food safety concept may be differently interpreted in different societies as food preparation and food consumption habits differ (for example, elaborate food safety checks for meat in a region where traditionally meat is boiled into a soup does make little sense). Shin *et al*. (1996) indeed demonstrate regional differences in willingness to pay for safer food products.

Animal registration and small-holders

There are a number of reasons why, especially smaller, developing countries have a problem to follow the rules and systems of their potential trading partners. Apart from the issues of tariff protection and subsidization, the main stumbling block is the mismatch between the sophisticated systems required for international trade and the transaction costs of reaching (and convincing) small-holders in developing countries. In the Netherlands, for example there are an estimated 30 000 cattle owners with 1.5 million cattle and an average of 50 cows per farm. In smaller Albania there are 310 000 cattle owners with about 430 000 cows or fewer than 2 cows per farm. Consequently the transaction costs of any farm service, including registration, in Albania are a dimension higher than in the Netherlands. Albania is not an exporting country and registration may not be urgent, and if farmers would elect to develop such as system it should be kept simple and transparent. Neighboring Macedonia, however, exports a part of its small ruminant production to the EU, and is more or less obliged to adopt an expensive registration

7 For review of food safety economics see Antle, 1999.

system for its livestock farmers[8]. This then becomes a difficult policy issue for Government as only a limited number of livestock farms are exporters (and beneficiaries), but EU rules require complete registration and tracing.

Apart from the scale issue (above) further problems relate to logistics of reaching a dispersed rural population in countries without good roads, telephone and reliable recording systems. On the other hand, labor costs are generally fairly low and fairly simple tracing systems can be designed (see Landais, 2001) that, however, are rarely accepted by international traders. The interesting associated problem is that administrators and researchers focus most attention on (blanket) adopting the systems from the West, and rarely spend resources on developing a cheaper local system that could potentially be accepted by trade partners and even by the World Trade Organization (WTO).

An additional benefit of individual identification is to help individual producers to identify best management practices and procedures. This is not an issue to small-holders who probably know their animals and their pedigrees by name, but will surely improve management of medium and large size farms . Some efforts have been made to develop recorded management systems by village or community (Faugère *et al*., 1991). Such systems appear to be cumbersome and expensive but may be useful under conditions of dispersed (small-holder) ownership.

Box 3. Implementation

In most western countries the implementation of animal recording is contracted out to parastatal or private organizations. In Canada, for example, the implementation is contracted to the industry created non-profit Canadian Cattle Identification Agency (CCIA). In the Netherlands the database is managed by the parastatal Animal Health Service (with oversight by the Livestock and Meat Commodity Board), in Tunisia by the parastatal Livestock and Rangeland Office. The UK, like the US, started with a mix of regional systems that are now centralized in the British Cattle Movement Service.

[8]Macedonia's lamb exports to the European Union were seriously hurt by a FMD outbreak in the Balkans in 1996.

Private or public investment

Traditionally, farmers identified their animals one way or another for the purpose of breeding or to prevent theft. In most family herds the animals were recognized by name. These were all private initiatives. More recently, however, the State (either directly or through parastatal organzations) has become involved in animal identification. Most of these tracing systems are currently being developeded, and the startup costs are generally carried by the State. The distribution of costs between the farmer and the state will depend also on the applications given to the identification. If it is only for food safety, there is a strong "public good" justification. Where producers would benefit also from the system through the use of breeding services, a larger share of the costs can be carried by the farmers. Indeed in most (western) countries an increasing part of the costs are carried by the livestock owners[9].

Box. 4 Should public sector support/finance animal recording?

Pro	• Control of movement and improved tracing will be overall beneficial to society. • Transaction costs of nomadic / transhumant herds, or for small holders, are too high to be carried by producers alone. • Better enforcement and statistics when state is involved. • Prevents tax evasion. • Public funds are needed to increase awareness and overcome producer objection. • Consumers may ultimatley benefit from safer products and from a lower risk of costly animal disease epidemics.
Con	• Benefits will be reaped by small selective group (livestock producers). • Intrusion of State in private activities (and risk of misuse of State power; first step to further intrusion, rent seeking and corruption). • Costly to producers and ultimately consumers. • Cost relatively higher to small producers. • Animal welfare objections against branding, improper use of ear tags etc.

[9]Assuming that tracing improves food safety, the consumers are as much a beneficiary as the producers. However, the cost allocation is easier by charging the producers, who should then include these charges in the costs of the final product. The downside is that some consumers do benefit more than others.

However, the cost of operating an animal tagging and identification system in developing countries is much higher than in most western countries, and some of these countries justify the involvement of the State for a number of reasons (see box 4). Such involvement does not necessarily mean the central state. In numerous countries the initiatives for public sector support derives from provincial or even lower levels of government. In India for example the cost of certain public sector activities are split between the central state and provincial Government. Moreover, these activities can be subcontracted to private entities such as producer cooperatives and other NGOs or to private veterinarians, private breeding services etc. Also, many of these models are based on trials on large farms and research stations, an environment that may not always represent the small-holder's system or interest.

Cost recovery

If indeed the industry has to pay (part of) the cost of the system an equitable method of cost recovery has to be established. Various tools are used. Most common is a levy on livestock sales or a levy on livestock ownership. Canada finances its CCIA through a Can $0.20 surcharge on the sale of eartags. The United States' (beef) Cattle Identification System (US-CIS; a voluntary non-profit organization) has been discussing three possible systems: (i) a surcharge to the purchase of ear tags, (ii) a fee per head, or (iii) a charge for services delivered (it was recognized, however, that in the latter case billing may be an issue).

Economic justification

Despite a vast literature about the technicalities of animal recording (See ICAR technical series) very little is known about its economics (i.e. benefits-costs). Disney *et al*., (2001) reported that, for the US, animal identification of cattle may provide "sufficient" economic benefits in terms of reduced risk of foreign animal disease, but that this may not be true for pigs. Their hypothetical study looked at a large registration system (40 million animals) for the United States. Their costs were low (about $2-2.50 per head) but excluded the start-up costs and the costs to the farmer. Start up costs vary but run somewhere between $ 500 000 to $ 4 000 000 for sizeable systems, which is low when amortized over millions of animals. The actual costs for the British Cattle Movement Service for 2000 / 1 were £. 22.6 million (US$ 33 million) but excluded the costs of inspection / quality control by the State (Hoskin *et al*., 2001). More telling may be a staffing of over 400 (just for the record keeping), which required about half of the overall operating costs. In contrast, the Canadian CCIA developed its database (from QC Data International, developed in about three years) for 14 million cattle with a State subsidy of Can $ 1.6 million and plans to

operate this with a staff of less than ten[10] funded by a surcharge on ear tags (currently Can$ 0.20). For comparison the US United Suffolk Breeders charge $5.- including tags.

Box 5. Broad outline of activities/actions

I. Feasibility

- Increasing awareness and dialogue about the perceived need.
- Determine "fit" with the national livestock strategy and market opportunities.
- Selection of competent implementation agency (for development phase) and sustainable financing mechanisms.

II. Planning

- Develop a national identification / movement control strategy.
- Determine which animals (species) to include in individual versus batch recording.
- Allocate necessary resources.
- Further education and information to increase awareness.
- Development of plan for database development and pilot testing.

III. Implementation (development phase)

- Project plan, budget and procurement method for developing database.
- Development of pilot plan and implementation.
- Development monitoring and quality control system.
- Allocate necessary budgetary resources for full implementation.
- Development implementation plan and procurement / tender.

IV. Implementation (execution)

- Prepare for full operation of system.
- System roll-out (phased).
- Monitor / assess operation and costs.
- Continue education and awareness improvement.

V. Post implementation

- Full surveillance / recording operating.
- Monitoring quality, costs and compliance.

[10]Personal communication, Ms. Stitt, CCIA.

Early - farmer initiated - programs, whether the objective was animal breeding or disease prevention, were indeed accompanied by crude cost-benefits analyses. Especially the breeding programs started locally, were farmer-initiated and managed, and the costs were fairly well controlled; much of the costs were kept down by volunteer services. Indeed even today some of the breeding programs are fairly cost effective. Review of such programs is relevant as they may provide lessons for countries or regions were breeding and animal control programs are currently being initiated.

Adoption of relatively expensive western models of animal identification is not only unaffordable in many developing countries but may be unnecessary. However this would require that farmers and their supporting bureaucracy make a sound case in international forums about the equivalency and compatibility of their systems[11], and that is the system is a best "fit" for their industry. Unfortunately this rarely happens.

Some experiences in World Bank projects

The World Bank has participated in the financing of a number of programs that aim to register animals. In some cases these were pilot programs to develop a system for demonstration or research purposes, in a few cases the project (component) financed a substantial part of the start-up and initial operating costs. As expected most of these programs are in eastern Europe and north Africa where the influence of the European Union is playing an increasing role in Government's decision making. In most cases the decisions to start an identification system are not well thought through, especially with respect to need, function, benefit/cost and budgetary implication. It is frequently seen as an extension of the breed identification system, without full appreciation of the implications of comprehensiveness, movement control and change recording, and the administrative costs of maintaining the database. A number of issues and experiences emerge, especially in policy dialogue and in project design and implementation. These include the following.

Policy

As discussed above the main policy issue is the justification of involvement of the state in a program that benefits only a small part of society. This is a political question that may have different answers in different countries, depending on the state budget, the perceived benefits to the country, and the economic and political power of the livestock sector.

[11]These differences stretch into the legal system views of liability. In the US the ex-post liability is largely driving the production and market system, whereas in Europe the control focused more on the product process and (state) control.

The second, somewhat related policy issue, is whether the Government's support should be provided to all producers (or regions) or only to those where the transaction costs are very high. In Tunisia, for example, the northern dairy farmers are well organized and use a European type of farming- and animal recording - system; in southern Tunisia, however, urban households may own one or two cows and there is a large transhumant sheep system. The latter are not willing and able to implement animal recording. To promote its uptake the Government is contemplating to financially support introduction of animal recording systems. However, the targeting of special groups is difficult for logistical and political reasons; and as such the northern dairy farmers may initially also benefit from Government support. But in other countries (and also expected in Tunisia), the large producers pay the full costs once the system is in place, but small-holders will continue to receive some state support. Again this is largely a political decision; in most cases the large farms (which may be exporters) are also the main beneficiaries.

Thirdly, the question to be posed in many countries is whether animal recording is indeed among the highest priorities in the long list of needs for improved functioning of the agricultural economy. In only a few cases have Governments presented a sound cost-benefit analysis and a system of cost recovery (but, as mentioned above, this is surely not only typical for developing countries). In a wider context this related to the overall costs of food safety program, which even in western countries may be prohibitively expensive (see below). Two additional policy questions that relate to state- or industry- mandated registration are the implications of mandated recording and the effect on the poor.

The political implications of enforced livestock recording

Especially in countries that just escaped totalitarian regimes there is a healthy suspicion among most livestock producers about State involvement. On the other hand there is great interest in recording etc. among the Government bureaucrats as they see this as a chance to claim back some of their power lost in the transition.

The effects on the poor

Enforced registration, especially with partly or full cost recovery from the producers may negatively affect the poor as there are strong economies of scale in animal recording. The poor producers[12] are rarely involved in either trading or moving animals around, and there may be few direct benefits to them, only higher costs and greater risks of being forced out of business because of non-compliance. The poor consumers will likely have to pay higher prices; in part because producers and processors have to

[12]Also in most developing countries, agriculture's share of the national economy is greater than in developed countries. Consequently, even if the costs are carried by the State, a large part will derive from the agricultural sector through taxes, levies etc.

recover their extra costs and in part because the official recording is sometimes combined with better taxation enforcement and consequently fewer opportunities for a (cheaper) gray economy[13].

Technical and financial issues

Technical and financial issues include underfunding and overall implementation.

Under funding

Some of the countries started the process of animal registration as an extension of earlier breed recording system. Apart from the infighting between various factions representing animal health or zootechnical interests, another common consequence is the under-funding of the program, as record keeping for tracing is very different, and more costly, than record keeping for breeding. Some countries were only interested in obtaining funding for the hardware (ear tags, some computers and programs) and grossly underestimated the human resources cost of managing and implementing an animal recording system as well as the time it takes to have a system in operation.

Implementation

As mentioned in some countries the breeders were the first to develop an animal recording system (i.e. milk recording). When a national recording system is proposed, the breeders feel that they should run the system, despite the fact that the objective of the nationwide system is tracing for animal disease control and food safety. On the other hand if the system is allocated to the veterinary profession there is a risk of a monopoly leading to relatively high transaction costs.

A common flaw is the lack of appreciation for proper movement control. An essential part of any registration system is compliance and control over movement of livestock. This is a crucial issue in the programs of many developing countries where animals are either free roaming around the village, take part in transhumant grazing and/or are moved on the hoof and there is an intermingling of animals from various owners. Movement recording, however, is the essence of animal tracing systems (and frequently the largest budget item of agencies managing animal recording). In pig and poultry production, the private sector (i.e. the vertical integrators) are increasingly taking the main responsibility for implementation (and for the costs).

[13]Some Governments (when dealing with small holders) recognize the high transaction costs and set a threshold below which it will not interfere (such as a income threshold for taxation purpose). This is not (yet) the case in food safety (and consequently animal registration) where a 100% compliance is expected.

The experiences in World Bank projects also point to the considerable time it takes to establish a sound recording system in countries where there is no history of recording and record keeping by farmers. Under such conditions the establishment of such a recording system may take at least a decade before being fully functional and with a reasonable assurance of quality data. Planners may keep this in mind when facing officials with optimistic scenarios of rapidly introducing such schemes. And international agencies such as WTO, Codex and even EU may also reflect about this when contemplating to require developing countries to buy-in and adhere to their rules.

Impact measurement

Finally, a common missing part of the project plan is the process of monitoring and the development of monitoring indicators. As mentioned above the impact of animal recording programs has rarely been quantitatively measured. Even in the EU, that has heavily promoted animal recording, the dearth of sound economic evaluation is striking. At most,

Box 6. Example of process and impact parameters

Process	Impact
• Number (or percentage) of animals or farms in the system. • Costs of registration per animal (per farm or per output) . • Turn around time when data have to be changed (especially related to movement). • Percentage incorrect data or (animal) passports. • Time it takes for producers etc. to obtain information.	• Improvement in response time to food scares or animal disease outbreaks. • Reduction in animal disease outbreaks or reduction in impact of food scares. • Improvement in food safety cost per unit product (i.e. before and after introduction of new system). • Rate of genetic improvement. • Satisfaction of major player (farmers, processors. • Ex post benefit / cost of investment. • Change in the number of disputes in national and international trade. • Change in turn-around time of trade dispute cases.

the evaluations use process parameters (number of farms or animals registered) or note the loopholes. Recent episodes on BSE and FMD demonstrate the existence of such loopholes and the difficulty of complete animal registration and movement recording.

The experience in the European Union with a long history of record keeping and sophisticated communication and database system does not bode well for the ease of introducing such systems in less well endowed countries. Proper impact measurement would require clear objectives of the investment, a baseline study, clear objectives and development of sound impact parameters. Apart from process parameters (see box 6.) a series of impact parameters need to be developed and monitored. In developing countries the parameters should include the impact on the poor (producers and consumers), and small versus large producers and processors and on sustainability in general.

Conclusion

Animal recording systems are not new. The comprehensive national systems that include tracing of animals, as recently mandated in the European Union and now in other countries, is relatively new. Most developing countries feel that they may have to follow the example of the large trading blocks and many may be forced to do so if their producers plan to export into these markets. Unfortunately the costs, and the benefit-cost of complete recording systems are not well documented, and governments planning to initiate a recording system may find that the costs and commitment are substantial, and that full implementation may take a decade. Especially non-exporting countries may carefully evaluate whether the costs of such system outweigh the benefits. Other countries may consider lower cost systems and argue that such systems are to be considered, under WTO rules, as equivalent and compatible.

Experience from the few examples of animal registration financed by the World Bank show a number of other risks, including under-funding the system, the lengthy debate and indecision about the implementing agency, a lack of appreciation that animal registration and tracing requires stricter movement controls, and the lack of quality controls. The need for monitoring the costs and impact should be an essential part of these programs.

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Animal performance recording in Kyrgyzstan: an essential tool for cattle improvement efforts

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Summary

The recent economic crisis has hit large collective farms, which resulted in an emergency at the new private farms. At present all available cattle are distributed among three types of farms: domestic households, small farms and large cooperative farms.

Currently in the rearing system of domestic households and small farms strong breeding occurs seasonally. The peak of calving seasons in the villages is in April. The reason for this is associated with herd management practised in villages. Cows are mainly bred naturally, which occurs in common herds mostly in summer when cows graze on a summer pasture. Additionally, there is a preference by farmers for their cows to calve mostly in spring. This tendency results in a smaller quantity of milk produced in winter in Kyrgyzstan.

The Central Asian Breeding Services Ltd., a company based on the principles of private enterprise and market economy was established in 2000. The objective of the company is to offer services to farmers to improve the performance of their livestock. Among other services, there is a supply of semen for artificial insemination and maintaining animal performance recording.

Today the Central Asian Breeding Services Ltd. renders its services for animal performance recording to both large cooperative and small private farms. Since the beginning of the animal performance recording, nearly 7 000 cows have been registered from 16 farms. The recorded data are entered into the database in the central computer. Farmers receive analysed information that enables them to identify the best cows and facilitate herd management (splitting the herd into groups of dried, calving and milking cows, etc.). The pedigree of cows is closely watched to avoid inbreeding in the herds.

Based on the data analysis results provided to farmers, animals' genetic merit can be better evaluated by means of calculated performance correction for various factors. By applying these average differences to an animal's phenotype, a more precise estimation of performance is obtained to select an animal with a better genotype.

There are other institutions which also supply semen for artificial insemination in Kyrgyzstan. The one that functions best is Emgek, a small bull station based on a large cooperative farm, which keeps Alatoo bull mothers' nucleus in Kyrgyzstan.

A few cooperative farms run animal recording on their own. Such farms managed to keep the recording system the way it was before the Soviet Union collapsed in the early 1990s. The system includes recording a number of traits to give so-called complex evaluation (type of selection index). Based on the complex evaluation, a cow forms one of the following groups: breeding nucleus, normal milking cows and culled cows. One farm, Emgek, estimates the bulls' breeding value. The farm evaluates the progeny of the bulls whose semen it uses. The estimation involves a simple comparison of bulls' progeny with the rest of the herd.

Due to the recent drastic changes in the political and market environment the animal recording system faces a problem, namely the lack of an acting breeding policy at national level, which hampers the development of animal recording. The herd book, which Central Asian Breeding Services Ltd. maintains, is financed by grants from Helvetas, a Swiss organization for development and cooperation. Thus, the development of services in animal breeding and particularly animal performance recording depends largely on foreign aid.

Introduction

The case study of Kyrgyzstan, a Central Asian republic is based on a very recent programme to reintroduce systematic breeding in cattle after the transformation from large collective farms to private ones. Some of

Table 1. Agricultural land (total area of Kyrgyzstan: 200 000 km^2). (Ibragimova, 1996).

Type of land	Area, km^2	Percent of total area
Summer pastures (1 500 to 3 500m above the sea level)	62 520	31.2
Winter pastures	22 590	11.3
Total pastures area	85 110	42.5
Cultivation land	16 000	8.0
Forest	12 000	6.0

the former collective farms have been transformed into private cooperatives, privately owned large farms and these farms have managed to maintain valuable breeding stock. The importance of the livestock sector in agriculture is determined by the availability of large pasture areas (Table 1).

Characterising the animal production system

Breeds

The cattle in Kyrgyzstan are mainly of the Alatoo breed. The breed has been developed over a long period by the complex crossbreeding of local Kyrgyz cattle with Brown Swiss and Kostromskaya. Alatoo cattle are of a dual-purpose breed, milk and beef, which corresponds to the current market situation whereby the milk-to-beef price ratio is 1:10. The genetic production potential (4 000 to 5 000 kg of milk) is higher than the current average milk yield (2 000 to 3 000 kg of milk), which calls for a lot of management improvement efforts. Animals of this type are very similar to Brown Swiss, they have a shorter body, deeper chest and a lower implantation of the legs. The udder is well developed and the milk yield is 10 to 15 kg per day. Thanks to productivity and adaptation to the hot dry summers and severe winters of Central Asia, the breed is widely used in the country as well as in other countries. During the period of breed perfection Kyrgyzstan has exported 59 500 heads of young animals to other republics of Central Asia, Caucasus, Mongolia, Korea, China, and Afghanistan. The level of improved (American) Brown Swiss blood has probably decreased over the past seven years, as Brown Swiss semen was used less in this period. The estimated population of Alatoo cattle in 1997 was 680 000 heads (Wageningen *et al.*, 1998).

The Kyrgyz Black & White cattle consist of three subpopulations: original Aulieatinska, "holsteinized" Alatoo and "holsteinized" Aulieatinska. The highest density is in peri-urban areas. Kyrgyz Black & White cattle, though not officially recognized yet, can be defined as a new breed group of dairy animals. Its genetic improvement can be found in a breeding programme similar to that of Alatoo. The Aulieatinska breed was created in 1974 by crossbreeding local Kyrgyz cows with Friesian bulls. The average milk yield of the cows was about 4 000 kg of milk per lactation. From 1980 onwards "holsteinization" of Alatoo started in 26 collective farms with the aim of increasing milk production. The estimated population of Kyrgyz Black & White in 1997 was 170 000 heads (Wageningen *et al.*, 1998).

Herd structure

The recent economic crisis has hit large collective farms, which resulted in an emergency at the new private farms. At present all available cattle are distributed among three types of farms as shown in Table 2.

Rear systems

There are two types of cattle rearing systems in Kyrgyzstan:

- the system where animals are housed year round; this system is more intensive and normally used in large cooperatives located around industrial and urban centres;
- mixed system with stall-feeding and grazing in summer or only grazing in summer on pastures and stall-feeding in winter; domestic households and small farms use this system more widely.

Currently in the rearing system of domestic households and small farms, strong breeding is seen seasonally. The peak of calving seasons in the villages is in April. The reason for this is associated with herd management practised in villages. Cows are mostly bred naturally, which in common herds occurs mostly in summer when cows graze on a summer pasture. Additionally, there is a preference by farmers for their cows to calve mostly in spring. This tendency results in a smaller quantity of milk produced in winter in Kyrgyzstan.

Table 2. Private farms in Kyrgyzstan (total cattle population: 850 000). (Wageningen et al., 1998).

Type of farm	Per cent of total population	Number of cows per farm
Domestic households	67	1 to 5
Small farms	25	10 to 30
Large co-operative farms	8	200 to 1000

Improvement efforts

Kyrgyz-Swiss initiatives

A Kyrgyz-Swiss project constructed a cheese factory in a rural region of Kyrgyzstan in 1996. The factory began to purchase milk from eight villages and later extended the procurement area to 20 villages. Next some centres for artificial insemination were established in the villages and collective farms around the factory. The project supplied bulls for natural service in village herds and launched a pilot programme for animal performance recording in the villages.

The Central Asian Breeding Services Ltd., a company based on the principles of private enterprise and market economy was established in 2000. The objective of the company is to offer services to farmers to improve the performance of their livestock. Among other services, there is a supply of semen for artificial insemination and maintaining animal performance recording, the activities taken over from the Kyrgyz-Swiss project. Today there are 40 centres for artificial insemination in villages and 16 on cooperative farms. They are supplied with semen, liquid nitrogen and equipment.

There are other institutions, which also supply semen for artificial insemination in Kyrgyzstan. The one that functions best is Emgek, a small bull station based on a large cooperative farm, which keeps Alatoo bull mothers' nucleus in Kyrgyzstan. The farm has 700 cows, purchases progeny tested semen and uses it to produce its own semen. Emgek imported 200 pure-bred Brown Swiss heifers from Austria and Germany in 1998-1990. Now the male calves of the imported animals are the breeding bulls that the bull station uses for semen production and natural service.

A secondary channel for flow of genetics, namely in villages, used to go through culled bulls from collective farms in the past. After the collective farms were either transformed into cooperatives or shut down, very few villages appear to have good quality bulls for natural service on the newly private farms. It is rare that a domestic household makes use of a good quality, commonly owned breeding bull. Instead, indiscriminate mating is widespread.

Animal performance recording

The initial objective of the pilot animal performance recording programme in the villages around the cheese factory was to test the feasibility of such a recording scheme in domestic households, closely contacting a large number of farmers and identifying potential bull mothers through systematic production comparison. Four hundred cows were recorded in four villages from 1997 to 2000.

Now the Central Asian Breeding Services Ltd. renders its services for animal performance recording to both large cooperative and small private farms. Since 1997, when recording began, nearly 7 000 cows have been registered from 16 farms. The recorded data are entered into the database in the central computer. The farmers receive analysed information that enables them to identify the best cows and facilitate herd management (splitting the herd into groups of dried, calving and milking cows, etc.). The pedigree of cows is closely watched to avoid inbreeding in the herds.

In 1999, the first cattle show was organized in Kyrgyzstan with the participation of almost all farms enrolled into the cattle herd book. Since then it has become the cattle breeders' annual event. The judgement at a cattle show is based mostly on external evaluation according to Brown and Holstein breeds applied to Alatoo and Black & White ones, respectively. The cattle allowed to enter the show are registered in the herd book and their evaluation marks are then updated at the next show.

Some results are summarized in Table 3 and Figures 1 and 2. Table 3 gives an overview of the scheme size. The data collected in the domestic households are considered versus small and large cooperative farms.

Based on the data analysis results provided to farmers, animals' genetic merit can be better evaluated by means of calculated performance correction for various factors. Figures 1 shows the relations observed between lactation yields and lactation numbers, lactation yields and seasons of calving. Applying these average differences to an animal's phenotype, a more precise estimation of performance is obtained to select an animal with a better genotype.

Figure 2 presents the seasonal influence on milk production level and breeding that is typical for animal husbandry in Kyrgyzstan today. The left graph shows that the highest daily yield is in summer. This happens for two basic reasons; firstly one is the seasonal feeding difference caused by grazing on pastures in summer and somewhat scarce stable fodder in

Table 3. Average 305-day lactation yields of the domestic households, small private and large co-operative farms.

No	Village	Breed	Domestic households	Cows	Average 305-day lactation yield, kg
1	Toktoyan	Alatoo	71	100	1 521
2	Sary Tologoi	Alatoo	79	101	1 711
3	Ken Suu	Alatoo	80	97	2 091
4	Santash	Alatoo	72	102	2 130
	Average		76	100	1 897
	Total		302	400	
Small & large co-operative farms					
1	KOSS	Alatoo		300	1 367
2	Kelechek	Alatoo		115	1 477
3	Jaiyl	Alatoo		343	1 543
4	Panfilov	Alatoo		58	1 660
5	1st May	Alatoo		42	1 688
6	Niva	Alatoo		162	1 781
7	Jenish	Alatoo		204	1 934
8	Zarya	Alatoo		849	1 935
9	Pahar	Alatoo		387	2 019
10	Engels	Alatoo		250	2 321
11	Drujba	Alatoo		290	2 532
12	Kirovets	Alatoo		779	2 779
13	Emgek	Alatoo		700	3 054
14	Bakyt	Alatoo		28	3 736
15	Vetka	Black & White		940	3 276
16	MIS	Black & White		1 467	4 733
	Average			432	2 826
	Total			6 914	

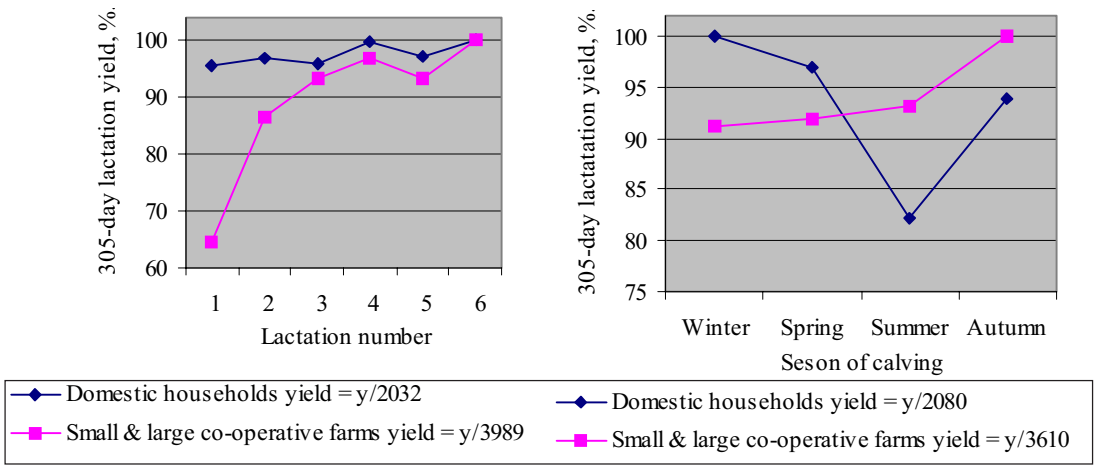

Figure 1. Relations between 305-day lactation yields and lactation numbers, 305-day lactation yields and seasons of calving.

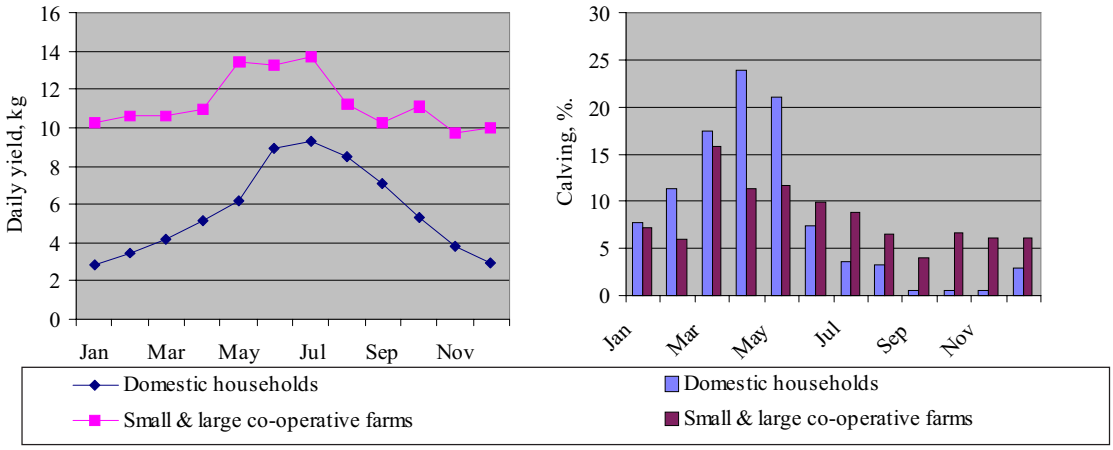

Figure 2. Seasonal influence on milk production level and breeding.

winter. The other reason is breeding seasonality that results from most cows calving in spring and being dry in winter thus producing very little milk in that period.

A few cooperative farms run animal recording on their own. Such farms managed to keep the recording system the way it had existed before the Soviet Union collapsed in the early 1990s. The system includes recording a number of traits (Table 3) to give so-called complex evaluation (type of

selection index). Data processing is maintained manually, on a special cow card. Based on the complex evaluation, a cow forms one of the following groups:

- breeding nucleus – mothers of the next generation that reproduce the herd;
- normal milking cows;
- culled cows.

The best cows are selected from the breeding nucleus to rear young bulls. The complex evaluation results help to design an individual mating programme. It also enables the design of a plan to complete the herd with young animals, increase cows' milk performance, sell and purchase animals.

Table 4. The traits included into cows' complex evaluation and the weights in points.

№	Trait	Maximum point
1	Milk yield and fat content	70
2	Conformation	10
3	Growth (weight)	5
4	Milking speed of the udder	5
5	Sire's and dam's complex evaluations	10
	Total	100

Only one farm, Emgek, estimates bulls' breeding value. The farm evaluates the progeny of the bulls whose semen it uses. The estimation involves a simple comparison of bulls' progeny with the rest of the herd. However, a large-scale breeding value estimation scheme outside a single farm does not currently exist.

Policy environment

The state system of dairy production, in which farms kept cattle highly concentrated in collective farms, has collapsed and Governmental support is no longer available. The Government issued a resolution on subsidizing farms but in reality no action has taken place. The lack of a reliable marketing unit that would trade surplus milk does not allow a milk producer to generate a stable income. Therefore, the milk producer has no guarantee on getting returns on investments. Thus, the newly emerging farms and organizations try to respond to the current changes.

Their aim is to improve efficiency of production by improving:
- genetic quality of the animals,
- feed and herd management,
- developing the processing and marketing infrastructures for milk and meat,
- veterinary service.

The objective of cattle breeding is countrywide availability of good quality cattle, which have genetic potential to efficiently transform available resources into milk and meat. This main objective has two components:
- superior cattle that can serve as pedigree stock for the next generations;
- centres for artificial insemination and good quality bulls for natural service.

Conclusions

Due to the recent drastic changes in the political and market environment the animal recording system faces a problem, namely, the lack of an acting breeding policy at national level. This circumstance hampers the development of animal recording. Despite the lack of a legal basis no finance for animal recording from either the Government or the public is available. Now, the herd book is financed by grants from Helvetas, a Swiss organization for development and cooperation. Thus, the development of services in animal breeding and particularly animal performance recording depends much on foreign aid. In the long run it cannot be sustained without local initiatives both from the Government and farmers of Kyrgyzstan.

Nevertheless the organizations, which currently render breeding services, are in turn responsible for the rate of development. By supplying high quality services, it is in their power to attract more farmers and necessary resources into the sector to promote sustainable development. A core factor of development is professional personnel engaged in the breeding sector, which needs education and communication with international animal recording organizations.

A prerequisite of animal recording development is readiness of farmers to accept new approaches and to use data for selection. To achieve this objective, generation changes are needed. Thus, animal performance recording is part of the whole development packet for cattle improvement.

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Successful establishment of small ruminant recording systems in the Mediterranean countries

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Summary

The paper analyses different production systems involved in the small ruminant sector in the Mediterranean area and the Near East countries.

A questionnaire was distributed among 22 countries of the basin and the collected data were used for estimation of breeding values and selection; extension services including feeding requirements, reproductive information and pathology patterns; support strategies for livestock development.

The investigation underlines the relative importance of the sheep farming sector while goats are less important everywhere (their numbers amount to less than one third of the sheep). The national frame for the different sheep and goat breeds recording schemes is also reported together with the different breeding objectives of the various countries.

The advantages of on-farm recording schemes for meat traits are described: mainly due to the extension service activity played by the technician when visiting the flocks and the testing of the males (through the daughters) in various flocks, which means in various conditions and environments; the French case study is also reported as an example of efficiency. Different recording schemes are described with the involvement of private and/or public sector, depending of the national organisation; the efforts in the countries are mainly concentrated on the recording of traits for meat and milk characters.

Recording of dairy sheep, mainly concentrated in the European countries, is demonstrated to be different from meat sheep due to a much larger number of animals involved in the schemes and because the activity started several decades ago. Examples of sheep milk recording in various countries are reported and an analysis of the costs is examined.

The goat milk sector is described and recording schemes similar to those of sheep are also implemented for goats. Although goat milk is economically less important than sheep milk, in all countries where dairy sheep are recorded, the recording schemes are fully implemented also for goats.

Two elements are necessary for a successful recording scheme either for milk or meat production: the genetic trend measured in one population for the trait that has been chosen as breeding goal after a certain number of years of activity and the amount of recording costs that is paid by the private farmer.

Introduction

The purpose of this paper is to give evidence of the way in which small ruminant production systems benefit from animal recording activities.

In general, data collected through these systems are used for three major purposes: estimation of breeding values and selection; extension services including feeding requirements, reproductive information and pathology patterns; and help to making national strategies for livestock development.

The organization of genetic / production improvement in sheep, as for livestock, involves several structures: breeders' societies; flocks; individual performance stations; progeny testing stations; nucleus flocks; and insemination centres. The key role is played by those who decide, for each breed, the selection objectives and then the means through which the objectives are pursued, therefore, either a farmer' association or a centralized body, the Government itself or sometimes some research organization.

In this paper, the existing examples of recording schemes will be examined and the benefits that each system entails will be evaluated.

Sheep and goat farm production systems and flock management strategies in the Mediterranean / Near East countries are extremely variable; the most striking evidence is that sheep can be considered either a dairy animal or a meat animal, therefore, the procedures to achieve the defined breeding goal are totally different in the two production systems and are thus examined separately.

Table 1. Importance of sheep/goat farming in the Mediterranean/Near Eastern countries

Country	Sheep (thousand head)	% dairy	Goats	Sheep / inhabitants
Lybia	6 400	0	2 200	1.1
Greece	9 290	100	5 520	0.9
Syria	15 000	0	1 200	0.9
Iran	53 900	0	25 757	0.8
Tunisia	6 600	1	1 300	0.7
Morocco	16 576	0	5 114	0.6
Algeria	18 200	0	3 400	0.6
Portugal	5 850	16	793	0.6
Spain	23 751	25	2 600	0.6
Turkey	30 238	0	8 376	0.5
Jordan	2 000	0	795	0.4
Cyprus	250	100	300	0.3
Italy	10 770	60	1 365	0.19
France	10 240	30	1 199	0.17

Source: FAO Yearbook, Production, vol. 53, 1999; Authors' survey.

In this context, the following is considered:

- geographical distribution and attitudes of small ruminants in the Mediterranean / Near East;
- the performed trials of performance recording, selection activity and their justifications;
- the obtained benefits.

Materials and methods

A survey through questionnaires was conducted in the following countries: Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, France, Greece, Hungary, Iran, Iraq, Italy, Lebanon, Morocco, Poland, Portugal, Slovenia, Spain, Syria, The Former Yugoslav Republic of Macedonia (TFYRM), Tunisia and Turkey. We thank the people who contributed to this paper by answering our questions. Their names, address and position are referred to in the annex at the end of the paper. Data were integrated with literature, seminar reports, web page information and other sources (www.dgv.min-agricultura.pt; Benyoucef *et al.*, 1995; Boujenane, I, 1999).

Results

The effort to establish recording systems and breeding schemes is worthwhile and the object of the programmes is economically important. To have an idea of the importance of sheep in the Mediterranean / Near East countries, Table 1 was drafted referring to the following figures and parameters: number of sheep (total head), percentage of dairy sheep,

Table 2. Sheep and goat breeds that are submitted to some kind of recording schemes, and their breeding goal.

Country	Species (S-G)	Breed / breeds	Breeding goal	Date of starting	Major responsible
Greece	S	Karagouniki, Lesvos, Sfakion, Serres, Hios, Frisarta, Mountain Ipiros, Kephalinias, Zakynthou	Milk	1980	Government
Greece	G	Skopelou	Milk	1980	Government
Syria	S	Awassi	Meat	1979	Government
Syria	G	Shami, Mountain	Milk	1979	Government
Iran	S	Qaraqul, Zandy, Kabudeh, Shiraz	Meat / skin	1990	Government
Iran	S	Zell, Sangsary, Shall, Lorybaktyary, Moqani, Lory, Afshari, Mehraban, Araby, Qashqae, Dalaq, Kordy, Taleshy, Kordy-khorasan, Bahmaee, Torkashwand, Haraky, Jomhoor, Kalhor, Shinbeh, Qezel	Meat	1990	Government
Iran	S	Makuee, Sanjaby, Baluchi, Kalekuhy, Nainy, Kermany	Meat / wool	1990	Government
Iran	G	Najdi, Adany, Talyi	Milk	1990	Government
Iran	G	Markhoz	Angora	1990	Government
Iran	G	Raieny, South Khorasan	Cashmere		
Tunisia	S	Barbarine, Noir de Thibar, Queue Fine	Meat	1990	Government
Tunisia	S	Siculo-Sarde	Milk	1990	Research
Morocco	S	Timadhite, Beni Guil, Sardi, Boujaad	Meat	1987	Farmers
Algeria	S	Hamra	Meat	1994	Government
Portugal	S	Merino Branco, Merino Preto, Campanica, Churra: Badana, Algarvia, Tenta quente, Galega bragancana, Galega mirandesa, Merino da Beira Baxa, Mondegueira	Meat		Government / farmers
Portugal	S	Saloia, Serra da Estrela	Milk		Government / farmers
Portugal	G	Algarvia, Bravia, Charnequeira, Serpentina, Serrana	Milk		Government / farmers

(to be continued...)

(... to be continued)

Country	Species (S-G)	Breed / breeds	Breeding goal	Date of starting	Major responsible
Spain (Basque country)	S	Laxta blond-faced, Laxta black-faced, Carranzana	Milk	1982	Farmers
Spain (Navarra)	S	Laxta black-faced	Milk	1986	Farmers
Spain	S	Churra	Milk		Farmers
Spain	S	Manchega	Milk	1987	Government
Spain	S	Segureno	Meat	1990	Farmers / government
Spain	S	Aragonesa	Meat	1994	Farmers / government
Spain	S	Merino	Meat	1975	Farmers / government
Spain	G	Malaguena, Murciano-Grenadina	Milk		Farmers / government
Cyprus	S	Chios	Milk / meat	1980	Government
Cyprus	G	Damascus	Milk / meat	1980	Government
Italy	S	Sarda	Milk	1930	Farmers
Italy	S	Langhe, Comisana, Massese	Milk		Farmers
Italy	S	Appenninica, Barbaresca, Bergamasca, Biellese, Fabrianese, Laticauda, Gentile, Sopravissana	Meat	1980	Farmers
Italy	G	Saanen, Alpine, Maltese, Ionica	Milk	1980	Farmers
France	S	44 pure breeds, Lacaune (meat)	Meat	1960	Farmers
France	S	Lacaune, Manech, Basco-Béarnaise, Corsica	Milk	1955	Farmers
France	G	Alpine, Saanen	Milk	1968	Farmers
Macedonia	G	Alpine, Saanen, crossbred with local	Milk	1999	Research

(to be continued...)

(... to be continued)

Country	Species (S-G)	Breed / breeds	Breeding goal	Date of starting	Major responsible
Slovenia	S	Bovec, Istrian, Bela krajina,	Milk	1982	Research
Slovenia	S	Jezerskosolcava, Texel	Meat	1982	Research
Slovenia	S	Saanen, Alpine, Boer	Milk	1988	Research
Iraq	S	Awassi	Meat	1966	Research
Iraq	S	Awassi, Arabi	Meat	1990	Research
Iraq	G	Black goat, Damascus goat	Meat	1990	Research
Egypt	S	Barki, Ossimi, Rahmani	Meat	1970	Research
Egypt	S	Farafra, Saidi	Meat	1996	Research
Egypt	G	Zaraibi	Milk	1996	Research
Egypt	G	Egyptian Baladi, Barki	Meat	1996	Research
Croatia	S	16 breeds	Meat	1994	Farmers / government
Croatia	G	Sanska, Alpine, Njemacka, Burska, Domaca	Milk	1994	Farmers / government

Source: Authors' survey; Cahiers Option Méditerranéennes, 1995 ; www.dgv.min-agricultura.pt

number of goats, and the ratio numbers of sheep/inhabitant (FAO, Yearbook, Production, 1999). This ratio gives evidence of the importance of sheep farming in each country and therefore of the opportunity of success that the establishment of a breeding scheme would entail. Countries are listed according to this ratio. In the table, only the countries where the ratio sheep/inhabitant was over 0.4 were reported, except when important breeding schemes were experienced even if the ratio was much lower.

From the table it is evident that for six countries of the Near East (Algeria, Iran, Libya, Morocco, Syria and Tunisia) and one European country (Greece) sheep play a fundamental role in the economy of the country.

Goats are less important everywhere: their numbers amount to less than one third of the sheep, except in Cyprus, where numbers of goats are slightly higher than those of sheep and in Greece and Iran where numbers are respectively 50 and 60 percent of the numbers of sheep. Therefore, if the mentioned ratio (sheep/inhabitant) is modified to sheep+goats/inhabitant, it is found that in Greece and Iran there is more than one small ruminant for each human being.

It will therefore be interesting to verify in which of these countries breeding schemes for small ruminants were implemented and what were the backgrounds, structures and eventually results.

The basic difference between sheep in North Africa and Western Asia and sheep of Europe is that in the first group of countries sheep are not milked, or maybe, they can be milked sometimes but their milk production does not enter in the marketing system. Recording and selection are therefore aimed to exclusively improve meat/fibre traits. In Europe, on the contrary, sheep milk in the marketing system is important: Greece and Cyprus 100 percent dairy sheep (although in Cyprus, for dairy sheep, also meat traits are recorded); Italy 60 percent; France 30 percent; Spain 25 percent; Portugal 16 percent.

All answers received have been condensed in Table 2, where the breeds that were submitted to any recording programme, the starting date of the programme and the organization running the programme are referred to, together with the selection purposes.

Meat performance recording

Of the necessary structures for the improvement of meat sheep, after the breeders' society which is responsible to decide on the breeding goals, the individual performance recording station plays a fundamental role: in fact, most of the traits have rather high heritability and they can be measured on the male. Stations allow accurate measurements and severe environmental control. Therefore, individual selection of young rams in the performance station is particularly efficient. Moreover, cost of

recording is lower in stations than on-farm. The most advanced form of the performance station is the one in which the males have been issued from planned mating. A nucleus flock is justified for populations of small size, because it provides conservation and multiplication of young stock. It is justified also in some developing countries, where shepherds are not prepared to participate in a breeding scheme, neither providing young rams to enter the performance testing stations or contributing to the cost of on-farm recording.

Also governmental flocks or research flocks in some developing countries could be considered as a kind of nucleus flock because they carry out the recording and selection activity with their own animals and staff with the purpose of spreading out the genetic improvement to private farmers through the sale of better animals.

A progeny testing station is justified if the traits to be recorded are not measurable on the male (like prolificity) and for the slaughtering characteristics.

On-farm recording is necessary for within flock female selection, for on-farm progeny testing (using AI males) and for management purposes. It is justified when farmers are prepared to pay for it.

Table 3 shows the importance of recording schemes for meat. It refers, for each country, to the number of non-milked sheep, the percentage that are recorded (considering any type of recording and registration of any event, on the farm or station); and the existing structures and facilities through which the recording/breeding activity is carried out. The fact that in the same country several structures are mentioned does not imply that everything applies to the same breed. On the contrary, in all countries there are several breeds, each of them has its own scheme and sometimes even different breeding objectives (Table 2).

From Table 3, the first evidence is that selection systems in all countries are based on the on-farm recording, either in associated flocks, governmental flocks or nucleus flocks (Algeria, France, Iran, Morocco, Portugal, Spain, Syria and Tunisia). On the contrary, in Italy only, the performance stations for males represent the fundamental means for the selection scheme. In France, the performance stations for males are only one of the components of the selection programme. We tried to analyse the difference in the interest of on-farm recording versus performance stations versus progeny test stations, and to understand why one tool is preferred to another in the different countries. The first point in favour of on-farm recording is the extension service activity played by the technician when visiting the flocks. It must be pointed out that a successful recording system must be based not only on the selection goal (genetics has long-term results, especially in harsh environments), while some benefits of this activity can be obtained in a shorter-term as an

Table 3. Meat performance recording: number of recorded sheep and structures involved.

Country	Total meat-purpose population (thousand)	% recorded	Structure of recording: On-farm	Structure of recording: Performance station for males	Structure of recording: Nucleus	Notes
Tunisia	6 600	1.7	Within flock selection	No	-	Recording activity fully paid by the government
Libya	6 400	-				
Syria	15 500	Irrelevant	no	No	Selection best rams for distribution to private	Selection is run by research staff of the government
Iran	53 900	1.0	Within flock selection	No	Selection best rams for distribution to private and AI	Selection is centralised in governmental flocks depending on the Ministry of Agriculture (no link with research)
Morocco	16 576	1.7	Within flock selection	No	Selection best rams for distribution to private	Selection is run by farmers'union: farmers pay .2 US$ for each animal in the program = 1/150th of the price of a female ewe aged 6 mo. The union receives a 4-yr contribution by the government, and appoints its own staff (42 people).
Algeria	18 200	Irrelevant				Selection is run by research staff of the government
Turkey	30 238	Irrelevant				
Jordan	2 000	-				
Portugal	5 200	1.7				Farmers' associations / Ministry Agriculture

(to be continued...)

(... to be continued)

Country	Total meat-purpose population (thousand)	% recorded	Structure of recording: On-farm	Structure of recording: Performance station for males	Structure of recording: Nucleus	Notes
Spain	17 000	2.9	Selection of best animals in all recorded flocks	50 stations (Segureno) 33 stations (Merino)	Selection best rams for distribution to private	Selection is run by regional administration. Cost of recording is averagely 6-10 Euros / animal / yr, the farmer contributing for about 15-20% .
Italy	4 000	4.6	Within flock selection and management	Selection best rams for distribution to private (all breeds)	Selection best rams for distribution to private (only Fabrianese breed)	Purpose of on farm recording is management. Selection is run by farmers'association (receiving 80% funding from government).
France	6 000	1.5	Among and within flock selection and management	Selection best rams for distribution to private and AI	One breed: INRA 401 (20 yrs. Activity)	Cost of recording is 1 kg meat / year / ewe; 80 % is paid by the farmer.
Croatia	461	13	Among and within flock selection and management	Selection best rams for distribution to private		Selection run by Croatian Livestock Selection Centre

Source: Authors' survey; Gabina, 1995 ; Cahiers Option Méditerranéennes, 1995.

improvement in the flock management conditions. Recording activity is a way to send a technician into the flock and to advise the farmers. Furthermore, we would add an important point in favour of on-farm recording. On-farm recording allows the testing of males (through the daughters) in various flocks, which means in various conditions and environments. The result is that we select not only production genes but also adaptation genes and fitness genes. This is of great interest, because it is possible to show that selection does not lead to a loss of adaptation and rusticity (important point in our Mediterranean conditions with local breeds and harsh conditions).

The major constraint of on-farm recording is the cost. The recording in the performance station is less expensive than on-farm recording; this is the only reason for which this system is used in Italy, where manpower costs are very high, and the farmers are not yet prepared to pay more than 20 percent of such costs. The Government therefore prefers to finance the building and the running of performance stations, where the activity is organized by the farmers' cooperatives themselves. In any case, the performance station system also requires the cooperation of the farmers in giving the stations their young rams, in participating to the planned mating and in contributing to the costs of the structures. Therefore, the farmers should be convinced that these activities bring collective progress. In Italy, performance recording of sheep for meat purposes is strictly finalized to produce top rams that are sold to the shepherds through auctions.

In France, finally, all the three tools of the selection schemes are used:

- performance recording on-farm in order to get data about prolificacy, milking ability (assessed from pre-weaning growth rate) and sometimes 30-70 day growth rate;
- recording stations (individual performance recording stations), where young rams, after a period of adaptation, are fed ad libitum during eight weeks (from the age of three months to the age of five months); records concern growth, conformation and fatness;
- progeny testing station for meat production (the best rams selected from the recording stations). Sires are mated to ewes and the progeny (30 lambs per sire) is measured for body growth and later carcass performance. A great number of traits are recorded at slaughter for genetic assessing of butcher features. About 10 breeds in France use the three tools in their selection scheme. The other breeds have a simpler situation, often without any progeny test step.

Therefore it is evident that France has achieved a more comprehensive control of the sheep production and selection system, proved also by the percentage of meat purpose recorded sheep (Table 3). There are two reasons for this success: the first is the long history of the recording activity in France, which has been carried out for decades through the constant cooperation of different organizations: the Government, research, and

most important, the farmers; the second is the gross margin per ewe, which is higher in France for the higher value that sheep meat products have compared to other countries. Traditionally, lambs, heavier lambs and mutton have an excellent position on the French market. In Italy, on the contrary, sheep meat is in many cases considered a by-product of milk and the demand is limited to local markets only.

Let us now analyse the difference in other systems of on-farm or nucleus flocks that arose from the survey (Iran, Morocco, Portugal, Spain and Syria). They are only apparently similar, but each one is unique. The Morocco example is the most similar to the European system: the nucleus is run by a farmers' organization; farmers pay a fee for each recorded animal and can buy the best rams issued from the nucleus, but not the very best, which are kept in the nucleus for the planned matings. Although the financial participation of the Government is necessary (the Moroccan farmers' organization receives regular fundings for this activity) the participation of the farmers is a must. In Spain also, the recording and selection activity is fully carried out by a farmer's cooperative, established at local level. Each sheep breed in Spain is reared in the region of origin. The Ministry has only a function of supervisor of the activity and gives partial funding to the farmers. In Portugal, the recording and selection activity is carried out by the *Sociedate Portuguesa de Ovinotecnica e Caprinotecnica*, strictly linked to the Government but in which the herd book farmers directly take part. It must be noted that the mentioned society has not only the purpose to improve meat productivity through recording and selection but also to promote the particular animal product from each breed. This is done through defining the production regulations for a type of lamb which receives a special denomination. Regulations include the age and weight at slaughter, the type of feeding and the area where it must be produced, etc. This aspect goes beyond the mere recording and selection purpose, but gives an example of the benefits that farmers can receive when they associate themselves and cooperate together to improve the breed.

The Iranian scheme, on the contrary, is totally run by the Government, which is the owner of the main nucleus flocks for each breed; such flocks or stations are nothing else but big flocks where selection objectives are pursued, i.e. where measurements and registrations of the traits, evaluation and selection of the top rams and *élite* ewes are performed within the flock itself. However, except for the rams that will be used for semen collection, the remaining best rams will be distributed to private farmers who participate in the recording scheme and are assured that some simple recording activity is performed in their flocks. In this case, on-farm recording does not contribute to the selection of the top rams among flocks, but helps the farmer to choose the female replacements. This system implies a will of the farmer to participate (in some cases he pays a reasonable fee). The uniqueness of the Iranian system is that it aims at long scale improvement of sheep production in the country.

In Syria, recording and selection activities are controlled by the Government, but through the national research institutions. There are few big flocks where sheep are recorded, evaluated and selected. The top rams, except those that will be kept in the selection flocks, are sold to private farmers, but due to the small numbers of evaluated rams, the benefits all over the country are irrelevant.

To date, it could be concluded that the final goal of sheep recording for traits concerning meat/fibre yield is, in all countries, the genetic improvement of livestock. If we would like to judge the success of such activities, the optimal indicator of the produced benefits is of course the genetic trend calculated over a consistent numbers of years. However, intermediate indicators could also be very useful, for example the circulation of better animals in the population. Therefore, Table 4 has been drafted, in which the numbers of evaluated animals are referred, together with the mention of the numbers of those that were considered the best rams, and those that were sold to private farmers. As not all replies have specified the numbers of evaluated rams and in order to have a rough estimate of the number of selected rams out of those evaluated, we assumed the total number of rams as half the number of ewes included in the selection scheme. Our purpose here is not to discuss about selection intensity, but simply to show how different the approach to selection could be. The number of selected rams is very variable: from 40 percent in Syria to 30 percent in Italy, to less than 3 percent in some breeds of Spain, and to 1 percent in France. It is evident that in countries like Syria or Italy the responsible organization for the selection activities prefers to distribute as many improved rams as possible instead of keeping the threshold too high. Many people are convinced that it is more fruitful to make the recording system known and appreciated through the sale of more animals than to limit the rams to be distributed to the very best ones.

Table 4 requires further comments. In most of the responses we received from the countries where several flocks are recorded, a common statement was that it is difficult to evaluate together rams of different flocks, as the flocks are poorly connected. In fact, even if they were connected purposely, through the exchange of breeding stock between flocks, it would anyway be feeble. Artificial insemination, which is the only way to create a reliable connection, is in fact poorly applied in sheep (Table 4). In this case, the evaluation of the rams in a performance station for males only is a means to overtake such a constraint; Italy has chosen this system also because AI in meat sheep is not very popular. In the performance stations, rams are simply evaluated from their own performance, after raising them in the same environment from the earliest possible age. However, with this system, female traits like prolificity cannot be recorded.

Table 4. Selection activity concerning meat sheep in the countries where performance recording is done.

Country	Means for selection	No. selected rams / year and % selected out of the evaluated	Number and use of the best rams	Number and use of the second best rams	No. artificial insemination intervention / year
Syria	5 experimental flocks with 1 800 ewes	400 (44%)	190 maintained in the flocks	210 sold to private farmers	-
Iran	Within flock (governmental and private) by expert judges	7 187 (7.4%)	500 for semen collection	6 687 sold to private farmers	30 000
Tunisia	250 recorded flocks	-	-	-	-
Morocco	Open nucleus (20 flocks)	202 (4%)	20 retained in the nucleus	182 sold to private farmers	-
Italy	Individual performance stations for 8 breeds	149 (46.8%)		149 sold to private farmers	-
France	1 648 recorded flocks; 23 individual performance test stations; 2 progeny test stations; 1 nucleus flock.	1 548 (1%)	550 sold to private farmers for controlled mating; 298 for semen collection	700 sold to private farmers for mating groups	60 000
Spain Segureno breed)	97 recorded flocks (12 000 ewes)	160 (2.6%)	110 retained in nucleus; 50 for semen collection		3 000
Spain Aragonesa breed)	172 recorded flocks (45 000 ewes)	-			10 000
Spain (Merino breed)	114 recorded flocks (68 00 ewes)	500 (0.7%)	500 sold to private farmers for controlled mating		
Croatia	739 recorded flocks (30 000 ewes)				

Source: Authors' survey; Gabina, 1995 ; Cahiers Option Méditerranéennes, 1995.

A further comment on Table 4 needs to point out the extent of artificial insemination; it is a practice still scarcely applied even in the more developed countries. This is a further hindrance for the genetic improvement of all the sheep population and not only a small group of farmers.

Conclusions about meat sheep systems

Although the recorded traits can vary from country to country, the only one which is considered important everywhere is the growth rate at a few basic ages. Moreover, prolificity and female traits, even if they are recorded on many occasions, are not, in general, included in any evaluation scheme.

We suppose that this is caused by the difficulty to set up an aggregate index, because of lack of knowledge of the necessary parameters, such as genetic correlations between the traits and computing difficulties. However, the collection of such data might prove useful in the future.

Finally, it must be mentioned that the recording of traits different than meat traits, such as skin yield and fleece, are not popular at all. In fact they are recorded only in Iran for some specialized sheep breeds and in France for the Merino sheep (Table 2). In these cases, skin or fleece quality and yield measurements are performed together with the weights and reproductive performances.

Two further experiences of sheep recording/selection activities need to be mentioned here. In fact, although the present survey was addressed only to the countries where sheep play a fundamental role in the national livestock production systems, valuable replies were received also from Egypt and Iraq. In these two countries, small ruminants are less important than cattle or buffaloes; however, either at local level, or for tradition, they substantially contribute animal food to human population. In Egypt, a continuous selection programme for meat sheep has been run since 1970 for three sheep breeds (Barki, Ossimi and Rahmani) and since 1996 for Farafra and Saidi breeds. It is carried out in four nucleus flocks, belonging to the central government and run by research staff of the national research institute. The nucleus flocks host about 2 000 ewes and 172 rams. Selection is done on the basis of post-weaning growth (males), prolificity, early age at lambing, interval between lambings and reduced seasonal anoesturs (females). Out of the young rams issued from the nucleus, 62 percent is sold to private farmers; 30 percent maintained in the nucleus and 8 percent used for semen collection (770 interventions/year). The management of semen as well as artificial insemination are carried out by the research institute.

In Iraq, from 1966 to 1990 a breeding programme was conducted at the University of Mosul, including 927 ewes of the Awassi breed; selection was done on the basis of early lamb growth, post-weaning growth, wool

Table 5. Performance recording and selection activity in milk sheep.

Country	Total female population (1000)	Recorded ewes no. and %	Indexed ewes (active)	Indexed ewes (active + historical)	Indexed rams (active)	Ai progeny tested rams / year	Indexed rams (historical)	Outputs for farmers showing genetic merits	Costs (litres milk / year) and % paid by farmers
France	1 395	877 747 (63%)	289 000	1 492 000	1 030	690	21 270	Electronic files edited by INRA	4 60%
Spain	2 377	111 900 (4.7%)	100 420	444 905	5 241	586	17 820	Ram catalogue; flock sheet for ewes	8.35 (20%)
Italy	6 147	418 271 (6.8%)	183 000	3 780 000	5 000	80	1 300 000	Ram publication in farmer's magazine	25 (20%)
Greece	9 261	55 832 (0.6%)	In course of preparation						? (0%)
Portugal	500	21 400 (4%)							??
Slovenia	2.8	1 162 (6.8%)	In course of preparation						25 0%
Cyprus	73.6	7 500 (1%)	4 000		3 500			In course of preparation	? 0%
Tunisia		2 000	-	-	-	-	-	-	-
Croatia	85 000	1 141 (1.7%)							

yield (males) and prolificity. Furthermore, a continuous selection programme for meat sheep has been run since 1990 for two sheep breeds (Awassi and Arabi) in nucleus flocks belonging either directly to the Government or to the Universities of Baghdad, Basrah and Mosul. About 2 000 sheep are reared in these flocks; selection is done on the basis of post-weaning growth, conformation and mature size (males), prolificity, maternal ability, early age at lambing, interval between lambings and reduced seasonal anoesturs (females). Moreover, wool quantity and quality are also considered. Every year 300 best rams are distributed to private farmers for use in mating groups.

Recording of dairy sheep

The milk performance recording and selection activity of dairy sheep (Table 5) is totally different for three main reasons: a much larger number of animals is involved in the schemes; the activity started several decades ago in most countries therefore the benefits are already evident; and it is performed only in Europe. The previous considerations allow a few comments and questions on the causes for that. In sheep farming, is milk production such a profitable activity that pays back the costs of the recording and selection activity? The answer to this question is very likely positive. A few comments on the costs will be given at the end of the paper; for the moment, evidence of the importance of selection in dairy sheep is given by the following figures:

1. Sixty-three percent of the French dairy ewes are milk recorded; a consistent percentage, between 4 and 7 percent is recorded in Spain, Italy, Portugal and Slovenia; about 1 percent is recorded in Greece, Cyprus and Croatia.
2. Common features of the recording activity in all countries is that it is carried out in associated flocks (only for one Italian breed, the Belice, is there an open nucleus system); a farmers' association plays the key role in the activity; connection is given by the AI or simply through the exchange of breeding stock from sales; calculation of genetic merit and animal indexing includes both living and historical animals (i.e. those that have been recorded in the past decade); all the recorded ewes enter the genetic evaluation system. The last item is a key factor to make the shepherd aware of the usefulness of the recording activity. When the records are not used for the genetic evaluation, it is difficult to explain to the farmers why he should join this activity. The publication of genetic indexes for all animals, through ram catalogues (Spain), flock sheets (Italy and Spain), electronic files available to the farmers (France) is a concrete response to the efforts of farmers, and also in other countries (Cyprus, Greece and Slovenia) the activity of milk performance recording in sheep aims to obtain this kind of output in the short-term.
3. Two interesting cases are found for the Lacaune sheep in France and the Chios sheep in Cyprus, where meat traits are also recorded and selected. The Lacaune breed is a particular case: the "meat Lacaune"

Table 6. Values of the genetic trends obtained for milk traits.

Trait	Breed	Country	Years	Genetic trend	Citation
Lactation milk yield	Lacaune	France	1980-1992	5.7 litres/yr	Barillet F. and Boichard D. (1994). Proc. 5th WCGALP, 18:111-114.
Lactation milk yield	Manech	France	1984-1992	2.1 litres/yr	
Lactation milk yield	Sarda	Italy	1990-1994	1.6 litres/yr	Sanna S.R., Carta A.,and Casu S. (1995). In Proc Symp. SIPAOC 7 Dec., 1995, p. 89-95.
Lactation milk yield	Laxta blond-faced	Spain	1985-1993	1.1 litres/yr	Ugarte E., Urarte E., Arrese F., Arranz J., Beltran de Heredia I. and Gabina D. (1995). Cahier Options Méditerranéennes, 11:155-164.
Lactation milk yield	Laxta black-faced	Spain	1985-1993	0.8 litres/yr	
Lactation milk yield	Manchega	Spain	1986-1992	0.8 litres/yr	Jurado J.J., Serrano M., Perz-Guzman M.D. and Montoro V. (1995). Cahier Options Méditerranéennes, 11:133-141.

strain (which has evolved separately from the "dairy Lacaune" strain for 50 years) organizes its progeny test for growth and carcass performance on dairy ewes; "meat Lacaune" rams are mated on-farm (AI) to "dairy Lacaune": the lambs are then fattened indoors and the carcass are "measured" at the slaughter house. In the Chios sheep post-weaning growth and prolificity are also taken into account in the selection scheme for milk production.

The cost that the farmer has to pay for this activity looks negatively correlated with the extent of the activity. In Italy and Spain, farmers pay only 20 percent of the total recording costs (while the Government pays 80 percent); in France, farmers pay 60 percent; in Cyprus, Greece and Slovenia farmers pay nothing. A suggestion might be deduced from these figures and from reports concerning the costs of the recording activity of different livestock in many countries, and this is that farmers should be first made aware of the benefits derived from the recording activity. It must be noted, however, that if French farmers currently pay 60 percent of the cost, at the beginning of the programmes (sixties and seventies), they paid maybe less than 10 percent. It is because of the success of the programmes that they pay 60 percent today. Given that the recording system has no short-term results and that the programmes must be collective, the Government must invest at the beginning. What is important is to make the transition when the programme is becoming successful. Nevertheless, the Government (or the research institute) must continue to realize some collective activities (calculation and publication of breeding values, collection and storage of data from recordings, etc.). Therefore, recording activity should be initiated providing incentives to the farmers or at least without asking them any fee; in some developing countries it proved successful to involve the farmers by giving them free feedstuff or vaccines (Trivedi, K., 2000); only after low cost useful information on individual animals, such as milk yield, conception rate, health parameters, are available, might the farmers be prepared to pay part of the costs to receive more and more information, including feeding advice from the monthly visit of the recorder and even the genetic merit of each animal of his flock. This activity should be supported by a continuous effort to increase the awareness of the benefits they could get from this activity: in this context the recording organization plays a very important role in finding the most suitable means to reach the farmers: meetings, seminars, workshops where scientists could be invited, stimulate competitiveness between them, etc.

Recording of goats

Although goat milk is economically less important than sheep milk, in all countries where dairy sheep are recorded, a similar scheme is implemented also for goats. Table 7 summarizes the situation. In Cyprus, France, Greece and Italy, selection in goats is a photocopy of the dairy sheep selection system. Less animals are involved, on one side because goats are less in number, on the other side because the schemes were

Table 7. Performance recording and selection activity in goats (milk yield).

Country	Total female population (1000)	Recorded goats no. and %	Indexed does (active)	Indexed does (active+ historical)	Indexed bucks (active)	AI progeny tested bucks / year	Indexed bucks (historical)	Costs (litres milk / year) and % paid by farmers
Iran	6 000	7 200 (1.2%)			370	44		? (0%)
France	800	300 000 (35%)			46 000	180	1 600 000	70 (50%)
Italy	700	25 000 (3.6%)	22 054	49 000	2 800			70 (20%)
Greece	2 600	4 254 (0.09%)						? (0%)
Portugal	470 000	24 500 (0.5%)						
Slovenia	13							25 0%
Cyprus	8	3 500			In course			? 0%
Syria	740	irrelevant	800		200			
Macedonia	?	800						
Croatia	39	2 774 (7%)						

implemented later on. Also the cost of recording is similar in the two species as well as the participation of the farmers. The same methodology is used for the data collection and genetic evaluation. In fact, in Cyprus, Greece and Italy, the same organization runs the scheme for both sheep and goats. In France the two schemes are run by separate organizations, but the second has taken advantage of the expertise and experience of the former one. Moreover, also Cyprus, Greece and Italy have taken advantage of the French experience, through visits, training received by that country and regular exchange of information.

Iran is the only country where a recording system for dairy goats was established, with no reference to any dairy sheep system (no milk sheep exist in Iran). The system was established in 1990, and it aims to achieve the genetic improvement of the breeding stock for milk within the overall goal to increase goat milk production in the country. As in the case of meat sheep, also for goats, in Iran, a highly centralized recording and selection system is employed, which is fully supported by the Government. Recording activity is performed in pilot (governmental) or associated flocks, with governmental staff.

As Table 7 only refers to the relevant data of dairy goats, we have to mention here that in Iran other recording systems and selection programmes are being run for goats, for fibre traits. This is the case of the angora production from the Markhoz breed, 1 200 recorded animals, i.e. 4 percent of total breeding stock; and also cashmere production from the Raieny and South Khorasan breeds, 8 600 recorded animals, i.e. 2 percent of total animals of these breeds. Recording of these breeds is also centrally organized, in pilot and associated flocks, controlled by governmental staff. For the three of them, beyond hair production and quality, also growth parameters are recorded, and selection within flocks is performed considering both fibre and meat traits.

General comments and conclusions

Small ruminants are often situated in harsh areas (mountains, dry areas, bad pastures), and the gross margin per ewe or goat is less important compared to cattle. These facts explain that recording systems are less developed than with cattle and are more difficult to establish particularly if we do not adapt the tools used in cattle. Consequently, the simplification of the milk recording systems (for example the use of AT or AC methods instead of A4 design) is very important in small ruminants if we want it to be developed and successful.

What is the meaning of successful recording systems, and how can the success be assessed? At least two items are necessary: the first is the genetic trend (Table 6) measured in one population for the trait that has been chosen as a breeding goal after a certain number of years of activity. In France (Barillet, 1997), it has been proved that the milk recording activity in sheep was successful because the average genetic merit of the Lacaune

animals was almost 6 litres of milk higher after every year of activity. For the other breeds (Italian and Spanish) the genetic trend ranged from 1 to 2 litres.

It should also be emphasized that a successful recording system must be based not only on the selection goal (genetic has long-term results, especially in harsh conditions): the recording system must also foresee extension service purposes; it is a means to send a technician in the flock and to give advice to the farmers.

A second parameter for judging the success of the activity is to consider the amount of recording costs that is paid by the private farmer: the higher this amount is, the more the farmers believe that the activity gives them some benefits. However, these positive examples have been preceded by several years where the government has played a fundamental role in directing and funding the recording and selection activity. In this context, it is important to point out that a successful recording system must be thought of with the purpose of improving all the given population and not only a small group of breeders: this is basically the problem of the diffusion of the progress. Unfortunately, in the majority of cases the diffusion rate is low (as an example, AI is poorly used). However, the involvement of the governments is fundamental for the starting of any recording activity, and the policy-makers should be made aware that the results of the recording activity will help them to make national strategies for livestock development.

Moreover, the academics have been and are still very much involved in some stages of the programmes, such as data processing, genetic evaluation methods, etc. and they still play a very important role in the promotion of this activity. Any effort from the government and/or a research institution to organize a recording/selection scheme should be appreciated, even if it is at a low scale at the beginning, and apparently has no impact on the livestock production system of the country. For this reason we would like to express a positive opinion for the examples where this activity is carried out by research institutions (Table 2): Egypt and Iraq for meat sheep; Slovenia and The Former Yugoslav Republic of Macedonia for dairy goats; and Slovenia for dairy sheep. These examples could be the starting point of a wider programme of genetic improvement if the academics succeed in involving private farmers and policy-makers.

Finally, the recording systems and objective of selection must be in interaction with the users of the products: milk industry, slaughtering, and also consumers. In this context, further outlets are emerging which can expand the recording activity and involve in this way more and more producers. Recording of traits like product safety, health and traceability is nowadays extremely important. From widening and improvement of the services offered to the farmers and the consumers, the farmers themselves will obtain more benefits. We would like to point

out again the useful actions of the Portuguese Breed Societies through the establishment of the production regulations for some types of animal products of the Portuguese sheep breeds (typical cheeses and type of lambs), which consequently require specific controlling actions, and reach the market as products of superior quality.

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(to be continued...)

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Recording systems for breed improvement and production management in transition and developing countries. A dairy industry perspective

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Summary

This paper describes the situation of meat and milk production in developing and developed countries in relation with either the future population trend or the different production systems. The need of increasing the production levels are briefly detailed in the light of the projections made at IFPRI.

Different milk production systems are briefly described comparing various countries: South American countries (characterised by a system in which cows graze privately owned natural and planted pastures) and other areas like Sub-Saharan Africa, where three quarters of the milk is produced by cattle, with common property natural pastures, providing most of the feed. In Asia, cattle and buffaloes produce equal shares of the total milk supply. The tight relations existing between crops and livestock are briefly summarised, providing a production system that offers more control over feed inputs than in pastoralist and agro-pastoralist systems and give a better base to facilitate recording and management.

The necessity of an effective and efficient milk recording system is stressed because monetary reward provides effective motivation for change. Examples of successful milk recording are recalled since this is the first step for a significant contribution to genetic improvement. At the same time the need of an adequate pricing and marketing policy is required since the interdependence of meat and milk have an important bearing on breeding policies.

Introduction

At present about 23% of the world population, living in developed countries, have a per capita milk consumption five to six times higher than in developing countries. However due to population growth, urbanization and rising incomes, there have been rapid increases in

aggregate consumption of livestock food products in developing countries between 1971 and 1995. Projections by IFPRI in 1999, suggest that 62% of the world's meat and 60% of the milk consumption will be in developing countries by 2020 (Delgado *et al*., 1999). This contrasts with the situation in the early nineties when the corresponding figures for 48% for meat and 41% for milk.

These changes in demand for animal products in developing countries, are placing unprecedented pressure on existing resources used in livestock production. The changes in milk production in developing countries over the period 1984 to 1998 were reviewed by Nicholson *et al*., (2001). In two developing regions, Latin America and the Caribbean (LAC) and Sub-Saharan Africa (SSA), increases in production were influenced more by increases in animal numbers and changes in herd composition towards increased milking cows, than by productivity increases. In the other regions increases in productivity were more important. In developing countries as a whole, overall production increased by 4.0% per annum, 2.0% from increases in animal numbers and 2.0% increase in milk per cow. Since significant proportions of milk production increases to date, have been achieved through increases in animal numbers, future emphasis will have to concentrate on greater efficiency in terms of output per animal and per unit of land and more efficient links between production units and marketing channels (Phelan and Henriksen, 1995).

The theme of the seminar is therefore both timely and challenging, since recording, monitoring and evaluation of information is the key to increased efficiency. Animal recording has a catalytic role in enhancing production and productivity. My former colleagues from FAO have described the livestock development setting in the first two papers and my task is to give a dairy industry perspective. Most of the participants have strong links with recording and animal breeding but this paper will approach the subject from a broader viewpoint of dairy development.

Breed improvement has been to the forefront of dairy development all over the globe and in many countries, animal recording is synonymous with milk recording. Milk production enhancement, through genetic improvement and feeding, has been an important component of dairy development projects, which the author has been associated with over several decades. There have been a number of examples where the choice of breed was inappropriate for the level of management and disease challenge in the recipient country but these have invariably involved inter government cooperation programmes and some have been spectacular failures. On the other hand, all the more widely known successful dairy development projects, like NDDB's Operation flood in India and the Milk Vita project in Bangladesh, owe much of their success to improved breeding and management in addition to market links.

This paper will first examine the milk production systems in developing countries, then review the recording systems used and finally look at the influence of pricing and marketing policies on the relative value of milk components, which in turn dictates breeding and management priorities.

Milk production systems

The location and type of milk production systems in developing regions is dictated more by market access than by other factors, but there are however characteristics which are region specific. With the exception of India and Pakistan, where buffaloes account for more than half the total milk production, cow's are the dominant source of supply.

In Latin America, most milk comes from cows grazing privately owned natural and planted pastures (de Leeuw *et al*., 1999). In Sub-Saharan Africa, three quarters of the milk is produced by cattle, with common property natural pastures, providing most of the feed. In Asia, cattle and buffaloes produce equal shares of total milk supply. Throughout most of the developing regions, small holders and medium/large-scale market-oriented dairy farms, tend to concentrate near or even within urban conglomerations to get better access to markets and efficient support services. Milk production may be moved to more distant locations only when the marketing infrastructure is efficient but such conditions are limited to India and part of Latin America and the Caribbean (LAC). Unit costs of milk collection and transport determine the potential for milk production in these locations.

There are wide variations within regions and the type and level of intensity of production. These reflect the wide variations in agro-ecological zones, availability of feed resources and culture and tradition in animal keeping (Nicholson *et al*., 2001).

Sudan, Kenya, Ethiopia, Somalia and Tanzania account for two thirds of cow milk production in Sub-Saharan Africa. In the arid and semi arid zones and in the highlands, there is a long tradition in cattle keeping and milk consumption (de Leeuw *et al*., 1999). In the more humid zones cattle keeping has been constrained by tick borne diseases and trypanosomiasis and sheep and goats predominate with minimal amount of dairy production. The highlands are the most productive in terms of milk production per unit area. In the densely populated highlands of Kenya and to a lesser extant in Tanzania, milk production has risen rapidly due to widespread adoption of intensive dairy production with cross breed and high grade dairy cows. The Kenyan dairy herd probably accounts for over 75% of all specialized dairy cattle in Eastern and & Southern Africa. (Muriuki, 2001.)

In Asia, the extensive agro-pastoral system, covers over 70% the total grazing land but produces only 15% meat and very low levels of milk production. Milk production in tropical Asia is concentrated in the

rain-fed and irrigated crop-livestock systems of India, which account for most of the dairy cows and buffaloes. India and Pakistan account for over 90% of milk produced in tropical Asia. In India milk is produced mainly from crop residues. Singh *et al*., (1997), show that two thirds of available feed originated from cropped land, 25% of which is irrigated. Forage crops provide another 12% and grazing accounts for only 14% of total feed. Dairy production systems in other parts of Asia, range from indigenous cattle communally grazed in relatively dry lowlands, to intensive zero-grazing enterprises with cross-bred cows producing 1500kg of milk per year and up to 11 tonnes of milk per hectare of farmland (de Leeuw *et al*., 1999)

In LAC the livestock systems can be grouped by eco-zone for the semi arid and highland regions and by production system in the humid zone. There are two systems, pasture-based and crop-livestock. The latter is more important accounting for 70% of cattle and 50% of land. Livestock are kept in the pasture-based production systems at high altitudes in the Andes and in crop-livestock systems at lower altitudes and in the valleys. Arable land in the pasture-based and crop-livestock systems in the semi-arid zones of NE Brazil, constitutes only 5.0% of total land but supports 15% of the cattle and 17% of the milk in the region (de Leeuw *et al*., 1999).

In all continents, crop-livestock farmers are able to benefit from the complementarities in feed resources and nutrient cycling, which increase overall farm efficiency. These systems provide more control over feed inputs than in pastoralist and agro-pastoralist systems and give a better base to facilitate recording and management. These crop-livestock systems generally support high rural population densities and the consequent pressures on intensification result in declining farm sizes and increasing reliance on purchased fodders and concentrates. Lactation yields have increased fivefold in some smallholder milk production units (de Jong, 1996). These more intensive systems are likely to account for the bulk of milk production in developing countries but they need more refined management to minimize environmental impact and achieve sustainable development.

The changes that have taken place in many of the countries in transition from centralized economies, have been dramatic and painful in many cases. Under the Soviet system, milk production was largely confined to state and cooperative farms with centralised processing and state marketing systems for dairy products, which took little account of actual collection, processing and distribution costs. There were only limited opportunities for farm workers to develop independent milk production systems. The collapse of the Soviet System and the associated political and economic changes, led to profound structural changes in the agricultural sector, a drastic reduction in livestock numbers and reduced availability of livestock food products. The management and reporting systems that were applied within the large units, with varying degrees of success, had little relevance

to the smallholder units resulting from the sharing out of land and animals. The distribution was arbitrary with senior officials getting larger shares and there was inadequate training to prepare recipients for their new role and as a consequence, the management levels were very low. While some countries in Eastern Europe managed to adapt, the processing and market infrastructure collapsed in many countries. The author was a member of an IFAD mission to study the livestock situation in Azerbijan and Georgia in 1999, where many producers were forced to sell productive animals to generate income in a downward spiral of economic activity. There is an urgent need to develop appropriate training, extension and marketing services to meet the needs of these livestock keepers and halt the decline.

Milk recording

An international workshop on Animal Recording for Smallholders in Developing countries was organized by ICAR in India in 1998, with assistance from FAO, NDDB and donors. The workshop attracted 45 participants from 25 countries and the proceedings of the workshop provide a valuable insight into the constraints and challenges to be overcome, when implementing animal recording programmes in developing countries (ICAR, 1998).

It was interesting to note that all eight recommendations of the workshop were directed at FAO/ICAR, rather than the participating countries but there were implications for the these countries. The first recommendation stated that FAO/ICAR should initiate pilot projects to demonstrate the economic benefits of animal recording. I wonder if any progress has been made towards this goal because monetary reward provides effective motivation for change. It was suggested that guidelines be developed based on principles of farmer participation, cost sharing and integration into local service/extension packages. The system should include all measures necessary for economic evaluation of animals, should be no more complex than necessary to achieve programme goals, and training should be provided.

Three different programmes were reported from India, each with distinctive features but all dealt with smallholders with 1 to 5 dairy cows. While the recording systems in Zimbabwe and Kenya, included special schemes for smallholders, they were essentially for larger herds as were other systems in Brazil. The reports on Malaysia, Sri Lanka, Vietnam and The Philipines, describe national efforts to provide smallholders with breeding services, including AI to improve genetic potential of animals. Availability of sources of dairy genotypes was cited by Walshe *et al.* (1991), as an important factor in establishing market oriented dairying. This service could be regarded as a public good and as such warrants Government support.

All participating countries reported dairy herd improvement programmes for cattle or buffaloes. The associated recording schemes to evaluate sires, dams and progeny are mainly at government, institution or donor project level. However, there was considerable variation in detail and quality of information gathered and in the rigour of data analysis. Recording at individual producer level was very limited. Most country reports at the workshop highlighted the difficulties in motivation of livestock owners , with one or two cows, to take even rudimentary records because of lack of appreciation of potential benefits. Some success has been achieved in places where marketing is organized as it is relatively easy to obtain data on the amount of milk delivered to collection centres, or sold. However every effort should be made to collect estimates of amounts used for home consumption, and amount fed to calves in order to establish total annual production per animal. Once this basic information is quantified, more detailed data can be added on calving intervals, age at first calving and cost of feed, which are the most important determinants of profitability. The more comprehensive the record keeping the more precise the management and this invariably leads to better margins.

The promotion of organized recording by Breed Societies and Farmer's Organisations, has made a significant contribution to genetic improvement, increased productivity and profitability in dairying in all regions of the developed world. The impact of milk recording in large herds in developing countries has made similar contributions in countries like Zimbabwe, Kenya and South Africa. Earlier this month the author saw an example of how the very sophisticated recording and management ALPRO system, supplied by Alfa Laval in Kenya, contributed to lowering milk production costs. The system identified each animal and dispensed feed in relation to yield and monitored amount eaten and signaled alarms when action needed to be taken. The reported production cost was considerably lower than any of the ten farms visited in the area.

The impact of milk recording in developing countries has been limited, particularly in smallholder dairying, due to shortage of organizations with the necessary know-how and financial resources to develop and sustain recording systems. There have been some success stories but these were invariably associated with projects that received donor support over a prolonged period. Operation Flood in India and Milk Vita in Bangladesh, mentioned earlier, are typical examples and are perhaps the two most successful dairy development projects over the last four decades. An FAO/UNDP dairy development project in Uganda, from the mid 1980s to the early 1990s, dramatically increased the amount of milk marketed in the country. The project promoted AI and recording as part of a substantial milk production enhancement component. FAO dairy development projects in Tanzania, Ecuador and Vietnam all demonstrated the potential of AI in upgrading dairy animals and increasing milk production.

Pricing and marketing policies

The requirements of the milk and meat processing sectors and the interdependence of meat and milk have an important bearing on breeding policies. Conditions of production and availability of land will naturally influence the choice of specialized or dual purpose animals. Government support schemes can also influence the trends in the industry but international trends towards liberalization have diminished the impact of Government policies. In Ireland, for example, government policies promoted beef and milk at different times and dual purpose animals predominated up to the 1970s when Ireland joined the EEC. The dairy sector supplied the majority of the calves to the beef industry in Ireland and Ayrshires, Shorthorns and Herefords figured prominently. The dairy exports were almost exclusively butter and milk was paid for on the basis of fat only. Entry to the EEC, opened up markets for milk powder, cheese and other dairy products and new markets for lean meat. The Irish Dairy Industry became much more specialized in order to exploit the market opportunities presented by the EEC price guarantees.

Friesian cows of Dutch, American, New Zealand and Canadian origin, predominate in the dairy sector and there is less interdependence between dairy and meat sectors. In parallel the beef sector also became more responsive to the needs of the export markets for lean meat. There has been a rapid growth in beef breeds such as Charolais, Simmenthal to supplement the traditional Aberdeen Angus and Hereford breeds. The shift towards specialisation has been accompanied by more intensive management and a greater emphasis on management information systems. The introduction of milk quotas by the EEC in the mid eighties, has put even greater stress on management to maximize profitability within the quota restriction. Despite these pressures, less than 25% of the dairy herd is subjected to organized recording. This contrasts with the Netherlands, where 75% of dairy animals are recorded and where genetic merit is also important in the context of semen export. New Zealand, another export oriented dairying country, has levels of recording intermediate between the two. Breeding patterns are also managed to ensure that the majority of the dairy herd is calving down when feed (grass), is most abundant. The concomitant seasonal pattern of production increases the cost of processing due to sub-optimal use of processing equipment and a shift in the product mix to shelf stable products like milk powder. Because most of the cost is incurred pre farm gate, the total cost of the seasonally produced dairy products is marginally lower and this can be critical in some export markets. However the relative profitability of short shelf life products may justify higher input milk production in the winter. Adjustment of seasonal production patterns may also be justified in developing countries to balance supplies in flush and lean periods.

The product mix will also influence the choice of breed or even species. Consumer preference for high fat content in milk in India, provides a premium demand for buffalo milk. Similarly in Italy, there is a large price differential between mozzarella cheese made from buffalo milk. Total

yield is the primary consideration when supplying the liquid milk market but milk composition determines the yield of dairy products and protein based products like cheese and milk powder are more expensive than fat based products. Selection criteria in breeding will therefore be influenced by the predominant product produced.

The success of selection programmes and changes in all aspects of husbandry and management has raised yields in dairy animals where health and other issues assume greater importance and breeding indices may have to be reassessed. A recent publication involving former colleagues in Moorepark Research Centre, Wageningen Institute of Animal Science and the Irish Cattle Breeding Federation, reviewed dairy cattle breeding objectives in Ireland under different milk quota scenarios (Veerkamp *et al*., 2002). The relative breeding index (RBI) used in Ireland, combines predicted difference for milk, fat and protein yields and protein content. The study suggests that under the prevailing quota conditions in Ireland, the economic values in terms of profit per cow per year, were high for % survival, kg butterfat, kg protein and negative for Kg of milk and per day calving interval. These economic values will be used in a selection index to select bulls for profitability in milk production in Ireland.

The microbiological quality of milk and the health status of animals is an over riding consideration for the processing sector and this is the most challenging aspect of milk production in developing countries. High ambient temperatures, poor hygienic conditions on farms and poor road infrastructure, make it very difficult to deliver high quality milk to processing plants or reach informal markets. Failure to address this aspect of milk production, will seriously undermine returns to milk producers. This could negate the undoubted potential of recording and breeding to enhance milk production in developing countries.

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FPR potential and weakness in management and breeding programme in transition and developing countries. The Indian experience

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Summary

The contribution of livestock sector to the gross domestic product of India is steadily increasing during the last decade. Milk contributes to some 67 % of the total value of livestock sector out put. The national policy for cattle and buffalo breeding emphasises for crossbreeding of the local cattle with exotic dairy breeds and grading up of the buffaloes with Murrah.

FPR integrated into the breeding programmes would be a better alternative to institutional farms for production of breeding bulls. A method for field based milk recording suitable for low input and small herd animal production system was developed and practiced by the KLDB since 1978. Its impact in terms of annual increase in first lactation milk yield of the crossbred cows (from 1 480 kg to 2 372 kg during 1983-1999), is worth five times the investment by the government. KLDB tested some 799 bulls in 23 batches from 1978 onwards and the proven bulls are routinely employed for the production of next generation bulls. BAIF employs FPR for selection of elite bull mothers and for evaluating the production of indigenous and crossbred cattle. Since 1994 BAIF is collaborating with the ICAR programme for progeny testing crossbred bulls. The DIPA programmes of NDDB have in all tested some 270 buffalo and 50 crossbred bulls and breeding values of 123 buffalo and 10 crossbred bulls have been estimated. The overall average first standard lactation milk yield was 1806 and 2 585 litres respectively for buffaloes and crossbred. NDDB succeeded in integrating FPR into the overall breeding programme of the milk unions. The ICAR progeny-testing programme envisages testing of 30 HF crossbred bulls in each batch.

FPR has the important roles of sire evaluation and bull mother selection in addition to monitoring of livestock performance at the smallholder level. Non-governmental organisations only could establish and run sustainable

FPR programme with the participation of farmers. A quick and simple method of FPR for estimating the milk yield would be necessary for states where introduction of a full-fledged FPR is difficult. A long-term strategy for integrating FPR into the breeding programme of the state and steps for cost recovery may be instituted.

Introduction

The livestock sector in India is linked with the livelihoods of millions of rural households and livestock production has always been an integral part of the farming systems. Almost 75% of the rural households own livestock of one type or the other and is more equitably distributed than land resources. The fact that 60% of the livestock owners are marginal and landless farmers support the claim that livestock related interventions are useful strategies for poverty alleviation.

India had some 219 million cattle and 94 million buffalo in 2000 (FAO, 2002). The average annual growth rate of cattle and buffalo population was 0.75 %, and 2% respectively, during the last two decades. The changes are also reflected in the dynamics of the cattle population (see Table 1): percentage adult females in the adult population progressively moving in favour of the female (from 43.1% to 50.4% in cattle and 78 to 86% in buffaloes); steadily decreasing proportion of adult breedable female among indigenous female with proportionate increase in the number of crossbred cattle. (GOI, 1992).

Table 1. Structural changes in cattle and buffalo population of India.

Details / Years	1972	1977	1982	1987	1992	1997*
Cattle						
Total (m)	178.3	180.0	192.4	195.8	204.5	210.4
Adult female (m)	56.5	57.9.	62.7	62.1	64.3	65.1
% Adult females –CB (m)			4.8	7.4	10.1	13.7
Adult fm % of total adults	43.1	43.6	46.3	45.4	46.4	50.4
Buffalo						
Total (m)	57.4	62.0	69.8	76.8	84.2	91.8
Adult female (m)	29.2	31.9	37.1	39.1	43.1	47.4
Adult fm % of total adults	78.4	79.2	82.4	84.0	84.2	86.3

*Estimate
m – million; fm – female.
(Source GOI 1997).

Livestock production systems

The predominant farming system in India is mixed crop-livestock farming, in terms of total production, numbers and number of people served. In this system livestock utilise the crop residues and crop by-products and in turn generate cash income, draught power & manure. Mixed crop livestock farming systems differ with the farming culture practiced by the holders; high-input-high-output systems as practiced in Punjab, low-input-low output systems (Haryana & Western Uttar Pradesh) and zero input-low-output subsistence systems (Orissa & Bihar).

There are some 11.85 million hectors of permanent pastures and grazing lands in India (Sastri, 1993). In addition around 121.1 million hectors are also used for grazing temporarily after the harvest of cereals and other seasonal crops. The pasturelands are not adequately managed for optimum yield and as such cannot sustain a good yielding dairy animal. Large livestock farms are rare and are mostly institutional farms. The few commercial farms that exist near the metro cities keep large herds of milking buffaloes. Transhumant livestock farming systems though still prevalent in India, the numbers involved, animals and human living a nomadic life are very few and are on the decline.

Inputs in livestock production

Feed and Fodder. The roughage requirement is met by agricultural and crop by-products and the estimated 7 million hectors of fodder cultivation would yield only 0.5 % of the roughage requirement. The total production of balanced cattle feed in the country is estimated as 5 million tons. Of the total raw materials available, about 25 % is milled as balanced feeds and the remaining fed directly to the animals (Chawla *et al*, 2002).

Management and health care. Management of crossbred stock was not satisfactory and has ended up in higher calf mortality, stunted growth, and infertility and poor milk production. While the extension support to the livestock sector provided by the state animal husbandry departments is oriented towards supply of inputs and providing of subsidies there is promising attempts by the milk cooperatives and NGOs. Livestock in India is ravaged by recurring epidemics, causing phenomenal production losses and lingering morbidity. The production losses due to diseases is estimated to the tune of 10 % of the annual out put value of the entire livestock sector (GOI.1996). Health services are provided to the farmers mainly by the state animal husbandry departments. Though the services are rendered free at the institution, only some 5 % of the budget is utilised for free supply of medicines and vaccines. India produces all most all medicines and vaccines required for the country.

Out put from livestock production

The contribution from livestock sector to GDP increased from 4.8 % in 1980-81 to about 6 % in 1998 –1999 (GOI, 2000). The estimated value of out put from livestock sector in 1998-99 was about INR 1 230.76 billion of which milk contributes to 67 %.

The growth in milk production in the country was faster than that of the world and other regions of the world (Figure 1) and is attributed to an emerging market for milk developed by NDDB. The annual compounded growth rate in milk production was around 5 % during the last three decades. The share of household income from dairy production for members in different land holding categories, showed that dairying provides 53 % of the income for the landless farmer and as the land holding increases the share of income from dairying decreases (NCAER. 1999).

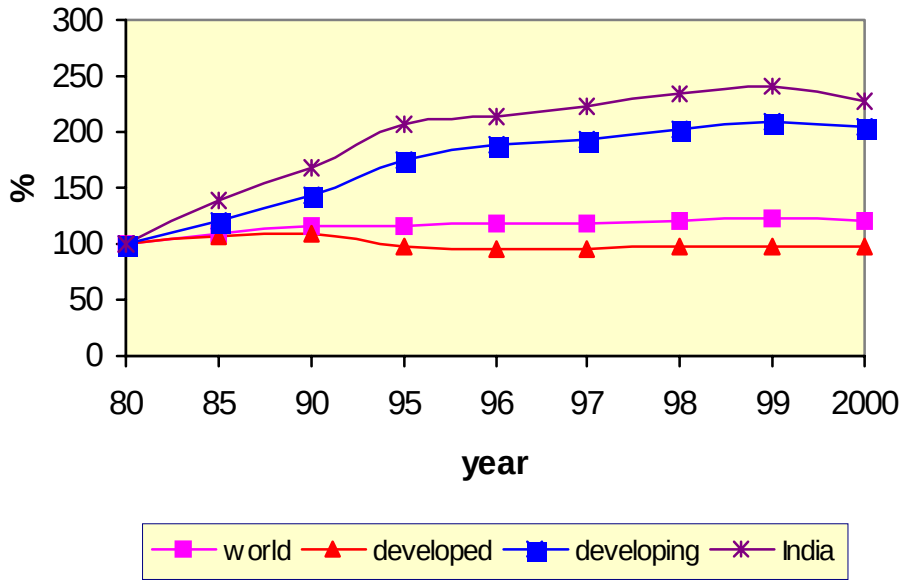

Figure 1. Standardised growth in milk production. (Source: FAO web site, 2002).

Breeding programmes

Breeding policy

The 26 different breeds of cattle, and 15 breeds of buffaloes, form only less than 20 % of the cattle and 40 % of the buffalo population of the country (Krishnamoorthy S., 1993). The launching of the intensive cattle development projects (ICDP) during early sixties all over the country, gave a direction to the cattle and buffalo breeding programmes of the country. The demand for milk produced by the milk cooperatives some 96 000 in number now, organised under the NDDB created the long felt need for genetic progress among the population.

The national policy for cattle and buffalo breeding postulated in 1962 emphasised the need for milk production increase through the use of selected dairy breeds of cattle and buffaloes in India. The use of exotic dairy breeds for crossbreeding of cattle gained momentum as the dairy co-operative network under NDDB provided the much needed market

stimulus and price incentive. The policy was to limit the level of exotic inheritance to around 50%. Jersey, Brown Swiss, Red Dane and Holstein Friesian were used initially but the choice has soon narrowed down to Jersey and Holstein.

AI for cattle and buffaloes is one of the most important services provided by the state governments. With some 63 frozen semen stations with a capacity to produce 36 million doses of frozen semen annually and 44 000 AI out lets, (30,000 of the government, some 12 000 by the milk cooperatives and the rest by NGOs and private practitioners) India has the world's largest AI infrastructure; some (GOI, 2000).

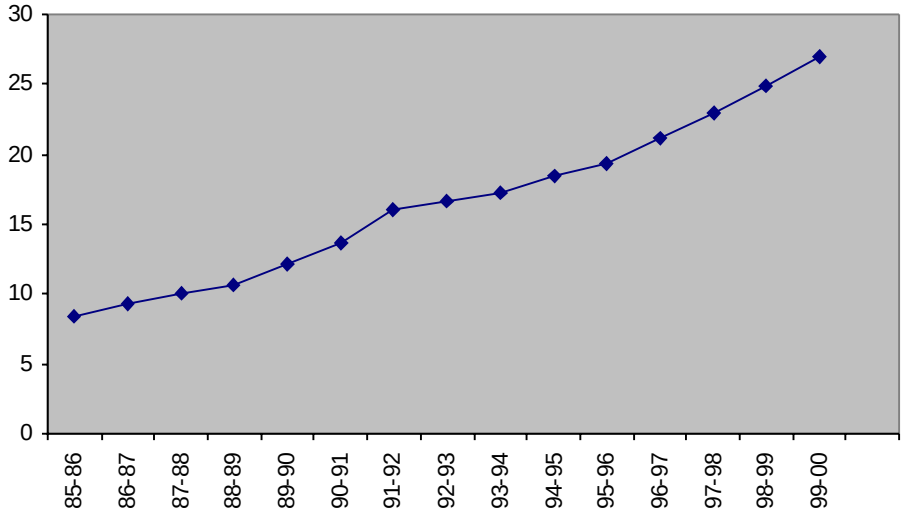

Figure 2. Growth of AI in India.

In all around 27 million AI are conducted in the country during 1999-20000 (See figure 2).The AI service at AI point is charged nominally and the charges vary between states; the maximum charge levied by Kerala state is INR 35. In most of the states the cost of AI is around the cost of one kg of milk. Almost 50% of the AI is conducted at the door of the farmer and invariably the inseminator charges for the door delivery extra. Though the growth of AI is steady only around 12 % of the population is covered annually. The impact of genetic improvement programmes varied widely between regions. Positive examples can be seen in states like Kerala, a result of the systematic approach initiated by the Indo Swiss Project, and Punjab, a state with a lot of fodder resources and hard working people. Breeding programme implementation failed in many states: there were lapses in maintaining the blood level at the prescribed levels due to non-availability of crossbred bulls, using genetically selected breeding bulls, ensuring quality of the frozen semen

and AI delivery. A national project for cattle and buffalo breeding proposed to provide farm gate AI service, create a national milch herd of cattle and buffaloes, support conservation of genetic diversity, improve the efficiency of the AI services, effect full cost recovery of the AI services by privatising the services and increase the coverage of AI to 40 % in the coming 10 years (GOI, 1997)

FPR programmes

Relevance of FPR

Government institutions and farms continue to be responsible for genetic improvement of cattle and buffaloes in India. It could be argued that the smallholder herds are too heterogeneous for a reasonably accurate estimation of genetic potential and government farms with reasonably large herds would provide better estimates. However it was not possible to benefit from the advantages due to the inherent weaknesses in the government system like, lack of clear objectives, non accountability, non availability of finances timely, decision making not at the place of activity, political interferences, etc.

FPR to select the best animals as bull mothers among the small herds with the smallholder will have the positive advantage of getting higher selection intensity and would cut the cost of bull mother production. A filed based progeny-testing programme cannot function with out FPR. It is a major task of the FPR organisations to properly involve the farmers. The recent attempt in Uttar Pradesh to institute Breeder's Association for the monitoring of the FPR programmes is found to be promising. Though the FPR programmes in India are not self-supporting, it can shown that the economic benefit, as a result of genetic improvement, will more than compensate the money spent by the government.

Development of FPR programmes in India

A method for field based milk recording suitable for low input and small herd animal production system was developed and practiced by the KLDB since 1977. BAIF started FPR to monitor the performance of crossbred animals in 1980 (Goe M R *et al*, 1998). FPR started as part of the Indian Council of Agricultural Research (ICAR) schemes during late eighties were discontinued, modified or shifted to new areas before demonstrating any measurable impact. NDDB started FPR for evaluation of breeding bulls both buffalo and crossbred cattle since 1987. The FPR for goats initiated in 1988 by the Indo Swiss Goat Project (ISGP) Rajasthan, employed it to select superior indigenous Sirohi bucks for natural service. The development of FPR programmes for cattle, buffaloes and goats are summarised in Table 2. (Chacko, CT, 1998)

Wherever it was a part of the breeding programme FPRs have been instrumental for genetic improvement of herds belonging to farmers. The average lactation yield of buffaloes in the DIPA villages increased from 1 600 litres during the pre - programme period to 1933 litres now (Trivedi, 2002). The first lactation milk yield of recorded animals in Kerala increased

Table 2. Field performance-recording programmes in India.

Organisation	Began	Breed or type	Objective
KLDB	1978	Sunandini	
BAIF Development Research Foundation	1980	HF, Jy, & their crosses Surti, Murrah, Jaffrabadi	Progeny testing & as part of the breeding programme
NDDB	1987	Mehsana & CB cattle	
Andhra Pradesh AHD	1988	Murrah & HF& Jy crosses	
Indo Swiss Project Sikkim	1995	Jersey crosses	Natural service bull selection
ISGP Rajasthan	1988	Sirohi goats	Bucks selection
Kerala Agric. Univ., Trichur	1986	Crossbred cattle	Research
Punjab Agricultural University	1988	Murrah buffalo	

from 1 480 kg to 2 372 kg from 1983 to 1999 (KLDB, 2000.) ISGP Rajasthan reported that milk yields and body weights of the local Sirohi goats were 50-75% greater than previous findings, which had been based on institutional herds (Groot, B.de.,1996).

Programmes run in the country

Kerala Livestock Development Board (KLDB)

The KLDB did pioneering work in developing a FPR system as part of a progeny-testing scheme. The impact of the FPR programme in terms of annual increase in milk yield of the crossbred cattle directly benefiting the farmers is worth five times the investment by the government. Initially the programme covered some 5 000 breedable Sunandini females, which increased to cover 80 000 animals by 1997 (Chacko, 1998). All Sunandini young bulls numbering around 40 annually are test mated each with 1 500 AI. The female calves born are registered and followed up till the completion of the first lactation. Around 50 milk recorders appointed on contact, control some 2 000 cows annually. KLDB tested 799 bulls in 23 batches from 1978 onwards. Till March 2001, 64 090 cows were enrolled for milk recording and 79 % of them gave completed lactation records (KLDB, 2000). Breeding value estimations of the bulls tested in the first fifteen batches are completed and the proven bulls are employed for the production of next generation bulls and proven semen is also made available for inseminating elite cows since 1995, on a premium price. FPR programme could identify the top cows in the FPR area, which were subsequently contract mated with the top proven bulls to produce replacement bulls. 1238 male calves born for such elite mothers were purchased (KLDB, 2000). Farmers support programme include

concessional animal insurance, free distribution of mineral mixture and dewormers. The government of India all through these years finances the running cost of the programme.

NDDB

The National Dairy Development Board (NDDB) has integrated FPR into its overall breeding programme by linking it with village level AI services as part of its Dairy Herd Improvement Programme Actions (DIPA). The DIPA programme started in Mehsana in 1987 was gradually extended to six other milk unions in Gujarat. Funding for FPR activities is obtained through milk sales and interest generated through a corpus fund established with contribution of the NDDB and the respective milk union. (Trivedi, 1998). While the implementation of the programme is the business of the concerned milk unions, it is the NDDB who provides technical guidance and professional support. The inseminator (employee of the local milk society) carries out the milk recording in all the milk unions; however Mehsana union is engaging the owners, since 1997 on experimental basis. A set of 20 bulls are put to test every year each with 2 000 AI with a view to produce not less than 60 completed daughter lactations per bull. NDDB practices a young bull programme; the genetic progress being ploughed in through the bull to bull and cow to bull paths. Male calves born for elite mothers mated to proven bulls are purchased by the AI organisation and brought up as future bulls. Female calves born for test AI are provided with 250 kg of cattle feed in five instalments each time the release is conditional to the proper growth of the calf. A management committee with representatives from the milk union and NDDB over see the implementation of the programme and provide the needed technical help.

BAIF

Bharatiya Agro Industries Foundation (BAIF) - Development Research Foundation is a non – governmental organisation, employs FPR for selection of elite cows for bull calf production and for evaluating the production of indigenous and crossbred cattle. The young bulls are progeny tested using the same infrastructure. The proven bulls' semen is used to mate the best 30% of the recorded herd.

GOI

Government of India is providing financial support for field progeny testing to the various states. Due to the absence of a clear objective and as progeny testing not forming part of the breeding programme, the schemes implemented in states other than Kerala and Andhra Pradesh were not successful. The animal husbandry department, Andhra Pradesh runs a progeny-testing programme with financial support from GOI for evaluating crossbred bulls from 1988 onwards. (Chacko, 1998). The FPR initiated in buffaloes by the Indo Swiss Project Andhra Pradesh (ISPA) is facing financial constraints since the discontinuation of the ISPA in 1995.

ICAR

A project for progeny testing of crossbred bulls in rural areas, began in April 1986 with the objective of developing a system of field recording and utilising the records for progeny testing of the bulls. This project was later discontinued but the interest of ICAR facilitated securing of GOI funds for the progeny-testing scheme. A new scheme was launched for progeny testing of crossbred bulls under field condition with the objective of developing methodology for computing genetic evaluations and estimating the accuracy of sire proofs during 1994. BAIF in Maharashtra, Kerala Agricultural University in Trichur, and Punjab Agricultural University in Punjab implement the scheme from 1998 onwards. The programme envisages testing of 30 HF crossbred bulls in each batch. Frozen semen for test AI is supplied by the Project directorate on cattle at Meerut. These programmes would generate a good amount of data on the performance of the crossbred cattle under field conditions in different ago climatic zones.

Use of information

FPR could well be an entry point for farmer participation in breeding. FPR can bring about real farmer participation and could be a feasible and better alternative to having nucleus herds on institutional farms. The KLDB results show that, the genetic potential of farmers' herds exceeds that of institutional herds. Furthermore, the selection intensity, which can be applied in the field, is much higher than in institutional herds.

FPR would be a means for local breed conservation and development. Only recently the potential of FPR for local breed improvement and conservation of biodiversity has been applied in the field. A general observation from all the areas where FPR is going on is value addition for animals under the FPR. Other potential benefits, which are yet to be tapped, are:

- Healthy competitions among farmers in the management of their herd. The milk societies can print out the ranks of cows under milk recording in the area.
- Suggest 'easy to practice' feeding regimes to the farmers based on the daily milk yield and considering the locally available feed materials.
- Advise farmers on efficient economic practices based on the reproductive data available from the FPR.
- Use for the planning exercises for breeding programmes.
- Research organisations can make good use of the information from FPR.

Results

A summary of the activities taken up by the major organisations carrying out FPR and the results are given as Table 3.

The average first standard lactation milk yield of the recorded animals plotted against the average of the daughters of the bulls tested through years given as Figure 4 confirms that the KLDB programme has significantly contributed to the genetic improvement of the cattle in the state. The first standard lactation milk is increasing at an average rate 3.3 % annually. The daughters average is also increasing steadily.

Table 3. Summary Statement of FPR programmes in India.

		KLDB	BAIF	NDDB	AHDAP	KAU
Period		78-00	80-99	87-01	88-97	92-00
Bulls tested		535	151	320	60	49
Bulls evaluated		441	112	123	60	34
Type of bull		CB	HF, JY, CB	Mehsani & CB	CB & Murrah	CB
Av. AI per bull		1 500	1 200	2 000	2 700	NA
Semen stored		3 000	2 000	5 000	3 000	1 000
Selection		YB	YB	YB	YB	
1st lactation	Cows	2 372	2 919	2 585	1 439	1 810
	Buf.	--	--	1 807	--	--
Comp. lactation %		79	70	20-25	62	46
Farmers awareness		Doubtful	Somewhat	Yes	Doubtful	Doubtful

YB – Young bull; HF - Holstein Friesian ; Jy- Jersey; CB – Crossbred
(Source: KLDB, 99-00; KAU, 2000; Trivedi, KR, 2000; Goe, MR, *et al*., 1997).

Table 4. Least square means for 305-day milk yield.

Effect of	Yield range kg	Highest yield	
Season	1710 - 1759	Rainy season	S
Holding size	1700-1769	50-99 cents	NS
Herd size	1563-1857	6 & above	S

The average standard lactation milk yield of the Mehsani daughters of the test bulls in the DIPA programme is ranging between 1 910 and 2 013 kg over the first six batches. The observation from the FPR by the KAU shows (see Table 4) that the season of calving and herd size has a significant effect on the yield.

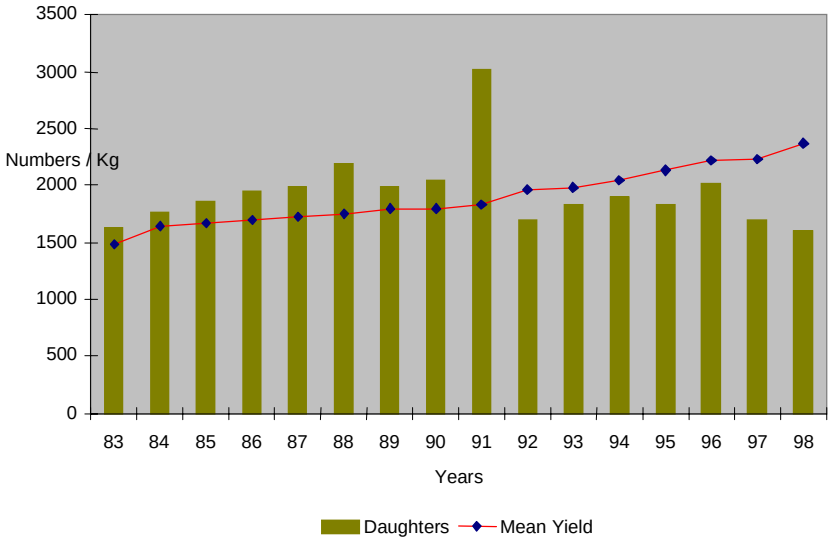

Figure 4. First lactation yield of crossbred cows in Kerala Source; KLD Annual report, 2000.

Strengths and weaknesses of FPR

Guaranteed availability of funds and resources are pre requisites for the sustainability of the project. The organisation implementing the FPR programme should have a reasonable autonomy to operate, a better understanding of its need and qualified persons for its management. Specific technical training in breeding strategies and FPR has received low priority in the last decade. Most technical problems within FPR are of a nature that they can be solved with a reasonable effort in research and development. It is felt that the early pioneering spirit in FPR cannot be found any more in many of the FPR programmes in the country. FPR is not a research project; it is an essential part of the breeding programme and as such is a continuous entity.

Strengths

- FPR as part of a well defined breeding programme: In Kerala and Gujarat FPR is employed for progeny testing and for selection of elite cows; and the context and role of FPR are well defined and accepted by all concerned including the main actors, the farmers.
- FPR as entry point for farmer participation in breeding: FPR can bring about real farmer participation. FPR can only be successful with true farmer involvement. In the KLDB and ISGP Rajasthan programmes this aspect has received adequate importance and attention. FPR is the most efficient tool for monitoring livestock performance at the smallholder level.
- FPR an alternative to large institutional farms: KLDB, NDDB and ISGP Rajasthan experiences show, that with FPR, the elite herd belonging to smallholder farmers can replace the bull mother herds

maintained by the government at least partially. The selection intensity, which can be applied in the field, would be much higher than in institutional herds.

- FPR as the base for local breed development: The potential of FPR for local breed development has been recognised recently by the milk federation of Uttar Pradesh under the World Bank programme for development of Sahiwal cattle and Bhadawari buffaloes.

Weaknesses

- *FPR has not been widely adopted*. In spite of its acknowledged relevance and reasonably well-documented results, FPR has not been taken up in a wider scale. It has remained within a few organisations and is not yet a mainstream methodology.
- *Government structures are not conducive for FPR programmes*. The problems faced in many states funded by government of India are instances that give the message that government set-up cannot successfully operate a FPR programme.
- *Emphasis in creation of awareness for FPR is not enough*. In spite of the well-documented evidence of the merits of FPR, efforts on a national level to create awareness on the benefits of FPR are not satisfactory.
- *The smallholder production system is not conducive*. For the smallholder, dairying is only one of the many sources of income. Some FPR organisations still do have a top-down approach and fail to get real participation of the smallholders.
- *Human and institutional developments not received sufficient attention*. The major bottlenecks of FPR are in the area of human and institutional development. Attempts to bring the scientists around a table for concerted action in the field of FPR were not common. NDDB would the apt body to initiate action on this regard.
- *The data analysis systems of the various FPR organisations have been developed in an iterative fashion*. All the models used are adapted versions of models used in FPR systems with larger herds. More specific research and development in this important area of FPR is needed.

Future directions

Should genetic progress to happen selection is inevitable and FPR is a prerequisite. Though there are not many alternatives for FPR, planners and administrators do not understand its necessity. All states should have a small but well run unit for progeny testing of their future bulls especially the buffalo, the crossbred and the widely used zebu bulls. This herd of animals should also provide a good number of elite cows to produce the replacement bulls through nominated mating.

Since government departments cannot handle the FPR, it shall be contracted to co operatives / NGOs / Autonomous bodies on a clearly spelt out memorandum of understanding and for a sufficiently long period.

In India it is now time ripe to introduce acts and rules to prevent falsification of FPR records. The penalties for offences done in FPR should be in par with that prevalent in other developed countries.

A quick and simple method of FPR for estimating the milk yield is to be developed for states where starting of a full fledged FPR is difficult with a view to select elite cows for production of young bulls. This would enable government to get rid off the large contingent of useless stock maintained in government farms, which are redundant for the purpose for which it is maintained.

Breeder's Associations may be formed in areas where FPR is taken up and they may involve in the running of the programme. A massive campaign for awareness creation about the essentiality of FPR is to be carried out at all levels (from planners to farmers).

A long-term strategy for integrating FPR into the breeding programme of the states and steps for cost recovery may be made. Value addition for proven bulls' semen, charging for managemental advice and assisting farmers in animal transactions, etc. should support the FPR programme on a long run.

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Economic and financing aspects of introducing and maintaining animal recording systems in smallholder farming in Slovenia

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Summary

Milk recording in Slovenia is performed according to A4 method. 74 000 dairy cows, or 6 127 herds are included to the control. On average this means only 12.4 dairy cows per controlled herd. Milk recording of herds is done by 235 recording persons, employed by the regional agriculture and forestry centres, founded by the Slovene Agriculture and Forestry Chamber. Twenty supervisors are in charge of super control, and twelve experts and technical staff of data processing. On average, the official recording person has to perform the control on 25 farms, or 314 cows. Milk recording is financed to a great extent by the government as professional duties of the Ministry of Agriculture, Forestry and Food. Breeders pay only the charges for somatic cell analysis. In 2002 the sum for the basic milk recording, super control and data processing, as well as providing the results to breeders will accounted to 14 091 SIT per cow, which means 217 kg milk at the average purchase price of 65 SIT. Because of small herds and the necessary economy of recording services, new methods, approved by ICAR are being considered, such as AT and B4 method. Reference A4 method should then be used merely in bull dams herds (350 herds) and in herds with outstandingly high milk quantity. AT method should be used in all the herds with at least 5 cows per herd (also on bigger farming enterprises). In all the other herds with less than 5 dairy cows, B4 method should be used and carried out by breeders themselves, where at least three yearly recordings would be performed by the official recording person. A4 reference method is planned to be used in all herds also for super control. 5 % to 25 % (5 % for A4, 10 % for AT, and 25 % for B4 method) of the herds should undergo super control annually.

Keywords*: Dairy cows, animal recording system, costs.*

Introduction

Within the borders of the Republic of Slovenia today, the first milk recording organization was founded in 1904 in Maribor, which was at the same time also the first such organization in the former Austro-Hungarian monarchy (recording was done only for the owners of the large estate). For smallholders milk recording started in Cešnjice, a settlement close to Selce, and was carried out by the Animal Breeding Organization in 1906. Soon, breeders associations followed in other parts of the country. Breeders' organizations expanded after the 1st World War in then so called Dravska Banovina, especially after the year 1930, and after the 2nd World War, the number of recorded cows started to rise gradually. First of all, milk recording was carried out in the herds of the large state farms. In the years 1970 to 1980, it spread also to the smaller farms, which started with intense milk production. In Slovenia, milk recording according to A4 method has been used since 1956 (Fercej, 1984; Pogacar, 1985; Osterc, 2001). In 1984 Slovenia applied for a membership of International Committee for Animal Recording (ICAR), although it was still a part of the ex Yugoslavia at that time, and in 1986 at the ICAR Session in Brussels Slovenia was appointed as a fully authorized member of ICAR and the INTERBULL sub-committee. For ten years we were trying very hard to obtain the dry ICAR stamp to be used on documents and recording results. In May 1996 we finally had a chance to receive the visit of two ICAR inspectors, Dr. J. Crettenand from Switzerland, and Dr. Batchelor from England. They examined the whole process of milk recording in Slovenia, from herd control, sample taking, milk analysis in the laboratories, data processing, herdbook keeping at our regional centers, to the registration of animals. At the 30th ICAR Session in the Netherlands, based on their report, Slovenia was granted the use of "*Quod scriptum est manet*" stamp on all the documents and reports, describing the origin and production data of our recorded animals ant their offspring (Klopcic, 1996; Pogacar, 1996).

Milk recording in Slovenia

In Slovenia, milk recording is carried out according to A4 reference method. The allowed interval between two recordings is 22 to 37 days. Each year at least eleven recordings must be taken per each controlled herd. Recording persons measure the quantity of milk of the evening and morning milking, for all the cows, milked on the control day. Milk samples are taken according to the ICAR recommendations of all the cows; the proportional part of both milkings. The samples are taken by the shortest route to the laboratories at the regional centers, where milk fat, protein and lactose content, as well as somatic cell count is determined. Some laboratories are equipped also for the determination of urea content from the milk control samples of dairy cows (Recommendations, 1996; ICAR Agreement, 2001).

As illustrated in Table 1, the number of recorded cows from 1970 to 2000, increased more than three times. At the moment, 71 000 cows are in recording, which presents 55 % of all dairy cows in Slovenia. As many as

Table 1. Number of recorded cows in the period from 1970 to 2000 per separate breed.

Year	Simmental	Brown	Black & White	Other	Total
1970	5 091	9 247	3 982	1 703	20 023
1980	16 063	11 362	8 694	1 638	37 757
1985	29 306	18 692	10 348	548	58 894
1990	29 253	17 038	11 402	431	58 124
1995	31 613	17 813	16 231	555	66 212
1997	30 888	16 774	18 219	879	66 760
2000	29 968	17 165	23 106	891	71 130

42 % of recorded cows are of Simmental breed, followed by Black & White breed (32 %), and Brown breed (24 %). Based on the Cattle Breeding Services report we can conclude that there are substantial differences among regions and in regard to different breeds. We can also conclude that in the year 2000 there was a total of 128 180 dairy cows recorded in Slovenia. 81.6 % of this total was of Black / White breed, 52.9 % of Brown, and 46.8 of Simmental breed.

In the last decade noticeable differences in breed structure of the herds in control can be seen. As the number of Simmental and Brown breed cows stayed the same, the number of Black / White recorded cows doubled in the years from 1990 to 2000. Even greater differences in breed structure of our herds are evident from data on the first inseminations of separate breeds in the last 15 years (Table 3). The number of first inseminations decreased 10 % in the last 15 years. The fall is most pronounced for Brown breed, because it dropped from 73 000 in the year 1985, to 27 600 in the year 2001. The 10 % decrease can be seen in

Table 2. Herd size and the proportion of the recorded cows in separate regions (year 2000).

Regional centre	No. of dairy cows	No. of recorded cows	The rate of recorded cows	No. of recorded farms	No. of complete lactations	No. of dairy cows / farm
Murska Sobota	17 599	10 079	57.27	1 549	7 569	6.7
Ptuj	23 970	14 440	60.24	1 089	11 451	14.6
Celje	26 575	13 447	50.60	973	10 782	14.5
Kranj	14 729	7 777	52.78	373	5 892	20.9
Ljubljana	36 141	19 234	53.22	1 543	15 802	12.7
Nova Gorica	9 166	6 153	67.13	670	4 107	8.8
Total	128 180	71 130	55.49	6 197	55 603	11.4

the number of Simmental breed, while the number of inseminations with Black / White bull semen increased (75 %), so did the number of inseminations with the semen of beef breeds (three times).

Although the number of recorded cows substantially increased in the last 15 years, the number of recorded herds dropped. This fact is the consequence of the concentration and specialization in milk production process. Small holders and elderly farmers abandoned milk production, also due to the strict hygienic and quality measures of purchased milk, and because dairies stopped milk collection in remote, and mountain regions. Thus, many breeders entirely abandoned milk production, they even stopped with cattle production and production of dairy cows. Some reoriented to suckler cow production, some to the production of small ruminants. Regretfully, many stables and cowsheds remained empty. Yet, on the other hand we have breeders who intensified milk production, enlarged their herds, and expanded the farms by taking the land on lease. Because in Slovenia we do not have milk production restrictions (production system quota), there are practically no limits for the size of herds or the quantity of milk yield. The restricting system is expected to be introduced in 2003. For many years in the past, the economic situation of our farmers was poor, especially in meat production sector, as well as in favourable conditions of milk production development. Therefore, the changes in the structure of breeds can be understood, namely in the case of Black & White breed, for these cows, compared to Brown breed, give 1 750 kg or compared to Simmental cows even 2 270 kg more milk in standard lactation (Klopcic, 2002).

In Table 4 the changes in the number of recorded cows in herds in the period between 1985 and 2000 are presented for family farms and for large scale state farms, separately. The number of state farms is decreasing rapidly; they only breed half of the stock they used to have in 1985.

Table 3. Number of artificial inseminations in different breeds in the last 15 years.

Year	B*	S	BW	RC	MB	Beef*	Total
1985	73 505	126 521	20 103	160	0	6 864	227 162
1990	56 262	116 642	22 672	42	0	7 436	203 054
1993	49 923	115 283	22 800	125	0	6 500	194 631
1995	45 079	119 291	25 468	170	0	10 557	200 565
1997	36 880	119 513	25 597	298	1 780	15 745	199 813
2000	29 338	113 827	33 257	359	0	20 703	197 484
2001	27 682	112 161	35 410	417	0	22 644	198 314

**B – Brown breed; S – Simmental breed; BW – Black and White breed; RC – Cika breed; MB – Montbeliarde breed; Beef – Beef breeds*

Table 4. Number of breeders and recorded cows in different sectors.

Year	No. of breeders in milk recording			No. of recorded cows		
	Family farms	State farms	Total	Family farms	State farms	Total
1985	10 030	56	10 086	49 147	9 747	58 894
1990	7 905	48	7 953	50 063	8 061	58 124
1995	7 797	31	7 828	59 404	6 808	66 212
1997	7 430	27	7 458	59 412	6 311	65 723
2000	6 196	23	6 219	65 709	5 421	71 130

Table 5. The average number of cows per recorded herd in separate sector and per recording person.

	Average number of cows per rec. herd			Total no. of rec. persons	Average no. of cows per rec. person
Year	Family farms	State farms	Total		
1990	6.3	168	7.3	245	237
1993	6.9	159	7.7	241	270
1995	7.6	220	8.5	243	272
1997	8.0	234	8.8	237	277
2000	10.6	246	11.4	235	303
2001	11.3	209	12.1	236	314

Changes in the size of herds on family and state farms are presented in Table 5. At the moment an average number of dairy cows per recorded herd is 12.4, which is too high compared to the average number on Slovene farms (only 4.17 cows / farm). Because of bigger size of herds, the average number of recorded cows per recording person increased from 237 cows in 1990 to 314 cows in 2002. At present, one recording person performs the control in 26 herds on average per month.

In Table 6 the dispersion of recorded herds and cows in the regional centers is presented. We can notice great differences in the structure of breeds and in the size of farms. Milk and cattle production is abandoned to a great extent in the regional centre of Murska Sobota and Nova Gorica, while the number of dairy cows show an upward tendency in the regional center of Kranj. However, the latter is the smallest in size, but has

Table 6. Number of breeders and recorded cows in separate regional centres (year 2002).

Regional centre	Number of breeders in MR			Number of recorded cows		
	Family farms	State farms	Total	Family farms	State farms	Total
Murska Sobota	1 500	-	1 500	10 300	-	10 300
Ptuj	994	1	995	14 235	165	14 400
Celje	998	2	856	12 498	80	12 578
Kranj	374	6	380	7 107	1 093	8 200
Ljubljana	1 147	8	1 155	12 738	2 462	15 200
Nova Gorica	749	5	754	5 354	951	6 305
Novo mesto	486	1	487	6 958	59	7 017
Total	6 104	23	6 127	69 188	4 812	74 000

Table 7. Average number of cows per recording person in different sectors (for the year 2002).

Regional centers	Average no. of cows per rec. herds			Total no. of rec. persons	Average no. of	
	Family farms	State farms	Total		Cows per rec. person	Herds per rec. person
Murska Sobota	6.9	-	6.9	35	294	43
Ptuj	14.3	165	14.5	47	306	21
Celje	14.6	40	14.7	38	331	23
Kranj	19.0	182	21.6	19	432	20
Ljubljana	11.1	308	13.2	50	304	23
Nova Gorica	7.1	190	8.4	25	252	30
Novo mesto	14.3	60	14.4	22	319	22
Total	11.3	209	12.1	236	314	26

outstanding production results compared to other regional centers, mainly on behalf of larger number of Black / White cows. In the year 2001 36 % cows were inseminated by Black / White bull semen, 56 % by Simmental, and only 8 % by the semen of other breeds (OC Report, 2002).

In Table 7 we can see the average number of cows per recorded herd in different regional centers. The smallest herds are, as presented, in the Eastern part of Slovenia, where milk production is abandoned on behalf of pig production, and in the Western part of the country (Primorska region), where due to unfavourable farming conditions, as well as aging

and unsuitable land ownership, the farms are greatly abandoned. A lot of people here are leaving the premises, and the rest of the population is getting old. In Table 6 different number of recorded cows per recording person can be seen: from 252 cows in Primorska region, to 432 cows in Gorenjska, depending mostly on the size of herds, and the distance between farms. On average, recording persons perform the control in 26 herds. In the regional center of Kranj they take records in 20 herds, since the herds here are so large that it is possible to do recording only on one farm per day. It is different in the region of Murska Sobota, where 43 herds are recorded on two, sometimes even on three farms per day. Very similar is the situation in the Nova Gorica regional center, where 30 herds are recorded each month.

For all seven regional centers, functioning in the frame of the Agricultural and Forestry Chamber of Slovenia, five laboratories are in charge of milk analysis. They are all equipped with milkoscans (of different capacity), and fosomatics to determine the somatic cell count. Five laboratories and all the others where milk analysis for the needs of Slovene dairies and milk payments are carried out, belong to the network of sample exchange. The laboratory of the Dairy Institute at Biotechnical Faculty, Zootechnical Department is regarded as the reference laboratory. It is in charge of sample exchange with other reference laboratories in Europe (France, Germany, Denmark) and adjusts its measurements according to the International organization INTERLAB. The other laboratories in Slovenia adjust their measurements with the reference laboratory in Rodica (Biotechnical Faculty).

Computer development and data processing

Computer programs for production control, herdbook keeping, and selection are written in CLIPPER. Since the beginning of this year a new information program is in use for cattle production, written in ORACLE. All seven district departments are equipped with PCs (386, 486, Pentium) joined in local networks. Similarly, but with stronger computers are equipped also both central institutions (Agricultural Institute of Slovenia, and Zootechnical Department, Biotechnical Faculty), where data processing and breeding value calculation is carried out. Here too, the computers are joined to the local network. Regional centers, laboratories for milk analysis, and both central institutions communicate by means of internet and e-mail. From district departments, data is sent daily, weekly or monthly to the central database at the Agricultural Institute of Slovenia, where data are processed and the results printed out. Feedback information from the central database are regularly sent by e-mail back to the local base at regional centers and to the laboratories.

Modern computer links offer new opportunities, so that data and recording results, registration and movement of animals, as well as the results of various tests will be collected only at the central database, while places of data input will be on different levels (breeders, recording persons, laboratories, regional centres, slaughtering houses, inspection offices, etc.).

Modern computer equipment, often present on the farms of advanced breeders, offers the opportunity of recording results to be received directly from the central database at the Agricultural Institute of Slovenia, by e-mail. On the internet the access to data on daily breeding value prediction for cows and sires is available. A team of experts at the Biotechnical Faculty, Zootechnical Department is responsible for breeding value predictions for milk yield and fertility traits. Lately, they are engaged in the development of a system, which will enable daily data collection of milk quantity per cow from milking parlour, equipped with lactocorders. These data will be a strong support in the introduction of AT, or B control. Based on these data it will be possible to observe the curve of milk flow for each cow separately, and constantly follow the oscillation in milk yield of separate cows. In those herds, where the animals are equipped with transporters and have automatic feeders, we shall be able to monitor the concentrate intake of separate dairy cow within the milk recording system. This means that by means of modern computer technique and the necessary information programmes it will be possible to inspect the concentrate intake and all the other manifestations in the herd (oestrus, health problems, diseases, temperature, climate, interval between morning and evening milkings, etc.). In return, breeders will get the processed results immediately after data processing and observations of daily happenings in the herd by e-mail, together with our recommendations and warnings, which will help breeders to improve farm management. Between the breeders and professional services the links for daily information transmission, and changes in the herd will have to be established.

Scope of recording services

Milk recording in Slovenia has a number of tasks in various fields. Milk recording results and prints help breeders to manage herds and farms to a great extent. It is very important that milk recording results are accurate and available to breeders as soon as possible (in two to three days after the recording). Breeders are helped to solve the problems in the herds by experts from selection, advisory and veterinary insemination services. Selection is managed by the help of selection service experts. Recording results and all the other information obtained by our service are very helpful to all expert services that are included in the production of quality milk, as well as the production of quality breeding animals.

Milk recording is of great importance also for the selection services. In Slovenia 200 000 cows and 20 000 heifers are inseminated every year. Last year, 90 % cows and heifers (198 314 animals in total) were inseminated, and 10 % of cows and heifers were mating (natural mating mainly in the herds of suckler cows). 74 000 cows, representing 55 % of all dairy cows is included in milk recording. About 600 cows are bull dams, which is less than 1 % of recorded cows. Prospective bull dams are selected and registered as mothers of future bulls on the basis of calculated breeding values and measured physical traits and exterior estimates. Bull dams are inseminated by semen of the best bulls of certain breed (domestic or imported).

Furthermore, milk recording is important from the national point of view. Data are often used also by other institutions and organizations such as the Ministry of Agriculture, Forestry and Food, Agricultural and Forestry Chamber of Slovenia, Veterinary Office, Breeders' Associations, Slovene dairies, meat processing industry, and Statistical Office of the Republic of Slovenia. Our milk recording results and breeding value calculations are also important for ICAR and INTERBULL. Our results are regularly sent to Paris and Uppsala for the international comparison.

Organization and financing of milk recording today and in the future

In Slovenia milk recording service is performed as a public service based on concession, which is granted by the Ministry of Agriculture, Forestry and Food. For the completed tasks, the mentioned Ministry ensures budgetary funds for as much as 95 % of the total costs. It also carries out the zootechnical inspection and supervision of the performed production control. Cattle Breeding Service of Slovenia is in charge of the working program preparations and the whole organization of milk recording system. It consists of the central service (Agricultural Institute of Slovenia, and Biotechnical Faculty, Zootechnical Department), and seven regional centers (Murska Sobota, Ptuj, Celje, Kranj, Ljubljana, Novo mesto and Nova Gorica), founded by the Agricultural and Forestry Chamber of Slovenia.

At present, almost all milk recording costs (95 %) are covered by the government. Breeders finance only the costs for somatic cell count analysis of a separate dairy cow. In Slovenia 236 recording persons and 20 supervisors are employed, responsible for milk recording and selection, partly also for cattle identification and registration, for performance test, herdbook supervision, as well as twelve professionals working on data processing at the Agricultural Institute of Slovenia, and milk recording system development at the Zootechnical Department.

The average cost of milk recording per cow is 217 kg of milk a year, calculated on the base of the average purchase price of milk, which is at the moment 65 SIT. The costs are financed by the government. In Table 8 the costs for the basic milk recording, super control and data processing

Table 8. Number of recorded cows and milk recording costs in SIT for the year 2002.

Regional centers	Number of recorded cows	Basic milk recording costs / cow	Costs of super control / cow	Data processing costs*	Total costs of recording / cow
Murska Sobota	10 300	12 472	1 123	950	14 545
Ptuj	14 400	12 363	1 113	950	14 426
Celje	12 578	12 472	1 123	950	14 545
Kranj	8 200	9 741	877	950	11 568
Ljubljana	15 200	11 406	1 027	950	13 383
Nova Gorica	6 305	13 907	1 253	950	16 110
Novo mesto	7 017	12 507	1 127	950	14 584
Total	74 000	12 055	1 086	950	14 091

**Data processing costs are the same throughout Slovenia and is carried out at the Agricultural Institute of Slovenia.*

for the year 2002 are demonstrated. Of the total milk recording costs, 85.6 % is meant for the basic recording (recording persons' salaries, traveling and material expenses, milk analysis fees). Further 7.7 % are the costs for super control and the official supervisors, which are responsible for the undisturbed field work in separate regional centers (work costs, traveling and material expenses, milk analysis fees for super control). Data processing costs for central database at the Agricultural Institute of Slovenia, represent 6.7 % of the total milk recording expenses, where work costs, maintenance of computer equipment and information system, and material expenses (prints, postage) are included.

Due to the increased interest of Slovene breeders to have other traits determined and measured, such as somatic cell count, contents of urea in milk, their interest for additional prints within milk recording services, they will have to pay part of the costs themselves. Governmental funds can not be expected to rise for this reason in the future. Therefore, a rationalization program is in preparation, as well as the reorganization of public service tasks in agriculture. Thus, financial resources will have to be rationally used for milk recording, herdbook keeping, for selection, and for improved efficiency at almost the same financial support. Serious consideration has already been started in connection with the introduction of AT and A4 method, both approved by ICAR, and the reduction of laboratories for determination of milk traits and milk quality analysis (in future, only one or two laboratories will perform the necessary work).

In future A4 method is expected to be used only in the bull dams herds (350 herds) and in herds with the outstandingly good milk yield. A4 reference method will therefore be used in about 500 herds with 15 000 dairy cows. This kind of recording would require 25 recording persons and two supervisors. In these herds only 5 % super controls will be needed. So, a minimum of 25 super controls would be performed annual; one per each supervisor.

AT method should then be applied in all the other herds with at least five dairy cows – also on large scale farming enterprises, which is 7 000 farms, supplying their milk to dairies and therefore in need of the milk recording results to observe milk quality and somatic cell count, as well as milk content of each dairy cow (milk fat and protein content, both the criterion for milk price determination). In such a way milk recording would be done for 60 000 cows. To accomplish this work, we would need 150 recording persons (each recording person would perform recording on 50 farms), and 14 supervisors. In herds where AT method will be used, super control will be carried out in 10 % of herds. This means that each year supervisors would perform 700 super controls. In spite of the substantial structure changes, we still have a number of small farms, having only 1 to 4 dairy cows and supplying their milk to dairies. There are still about 6 000 such breeders, having 20 000 cows in total. In the future the number of these farms is expected to reduce. Many of these breeders will stop dairy cow production. Yet at the moment they still get a certain minimal income from milk, and additional payment for the production of breeding cattle, therefore they wish to be included to milk recording system. They can observe milk content and milk quality, and the information on purchasing of breeding cattle). This is the reason why we considered the introduction of B4 method as most suitable for the smallholders, also from the financial point of view. To avoid the possible tailoring of the results, at least three yearly recordings according to A4 method should be necessary and done by the official supervisor. Three recordings would at the same time be three super controls. For this type of recording 60 recording persons and four supervisors would be required. Thus, 1 500 recordings (25 %) would be performed on these farms by the official recording person.

For the expanded capacity of the basic milk recording for the entire milk production (95 000 dairy cows) a total of 235 recording persons, of which 25 would be in charge of milk recording on farms where A4 reference method would be used (500 herds and 15 000 dairy cows), 150 recording persons for farms where AT method would be used (7 000 herds and 60 000 dairy cows), and 60 recording persons for smallholders where breeders would be recording on their own according to B4 method (6 000 breeders and 20 000 dairy cows). Here, breeders would take recording once a month, and the official recording person thee recordings per year. Three official recordings would also be super control at the same time, performed for the sake of data reliability and verification of the results.

To perform super control in all the 13 500 recorded herds we should need 20 supervisors. They would be in charge of at least 1 225 super controls annually, using A4 reference method. No additional stuff would be required for data processing and print outs in spite of work extension. New financial sources would be sought only for the continuous education of recording persons, supervisors, and for milk recording process development, which will have to follow ICAR recommendations and at the same time take the advantage of offered new opportunities by modern computing equipment and well developed information system.

Conclusions

1. Milk recording in Slovenia is at present performed according to A4 reference method.
2. Milk recording costs per recorded cow / year accounts to 14 091 SIT, which means 217 kg milk at the average purchase price of 65 SIT.
3. For the basic recording of dairy cows 236 recording persons are employed, and 20 supervisors, as well as 12 experts for data processing. On the average each recording person works on 26 farms with more or less 314 cows per month.
4. The highest expense represent salaries of recording persons, as well as transportation fees, often higher because of unfavourable distribution and remoteness of farms. Very high are also milk analysis, which are at the moment done in five laboratories, more so because the capacities and the staff in these laboratories are not sufficiently and entirely used.
5. To use the financial resources for milk recording process as rationally as possible (A4 reference method is relatively expensive) with the obligatory increase in the number of recorded cows, as well as more efficient super control system in the regional centers, we are forced to consider the introduction of cheaper, but still accurate recording methods, approved by ICAR.
6. At the Ministry of Agriculture, Forestry and Food an extensive analyses on the present work of professional services is in progress, with the aim to find additional possibilities of rationalization and better work efficiency of super control. Future work will run according to the proposal of the possible fulfillment of expert work in milk recording system in the following variants:
   - A4 method will be used in bull dams herds and in herds with outstandingly high milk yield (500 herds and 15 000 dairy cows).
   - AT method will be used in herds with at least five dairy cows, also on bigger farming enterprises, which supply milk to dairies (7 000 herds and 60 000 dairy cows).
   - B4 method will be used for smallholders with less than 5 dairy cows, who supply their milk to dairies, and who also produce breeding animals (unfavourable regions, elderly farmers). At least three milk recordings, at the same time super controls to check the quality of work and verify data accuracy (6 000 herds and 20 000 dairy cows) will be performed.

7. This way 90 % of dairy cows (95 000), supplying milk to dairies, will be recorded. The expansion will require 235 recording persons and 20 supervisor, as well as twelve experts and technical staff for data processing. This means that with the same financial quota (a possible rise will only cover the inflation), with the participation from breeders up to 10-30 %, and starting with cheaper and rational milk recording methods, we could include additional 21 000 dairy cows to milk recording process. The cost would in such a case be 160 kg milk per dairy cow, at the average price of 65 SIT per kg of milk.
8. Recording in smaller herds is necessary to keep cattle production alive in areas, where unfavourable conditions and geographical layout do not permit production of larger herds. Here, farmers can still produce breeding cattle and thus earn an additional income.
9. Super control in all the herds, regardless the method for the basic milk recording will be performed according to the reference A4 method. Supervisors will have to be specially trained experts, totally independent, yet directly responsible to the Ministry. Agricultural inspections will, in accordance with the new Animal Production Law, implement zootechnical inspection of the tasks more frequently.
10. The new Animal Production Law came into force on 12.2.2002. It brought the complete transfer of EU laws to the Slovene legal system, to legalize all the professional work covering milk recording and selection process.
11. Expanded milk recording work with the same number of recording persons and supervisors will to our expectation increase the quality of recording and selection work, increase the intensity of selection, improve the service to breeders with the provision of monthly milk recording results, to help breeders manage their farms, to improve the quality of market milk production. Additionally, breeders will get the chance to increase the income per each farm because of greater market opportunities for breeding cattle.

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Animal health links to recording systems. Resistance to internal parasites in sheep

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Summary

Traits related to health have been given limited attention by ICAR. Gastro-intestinal parasites are a major burden to sheep production especially under extensive grazing conditions. One important trait is fecal egg count (FEC) used both to measure resistance of helminths to drugs, and resistance of sheep to internal parasites. There is ample evidence that resistance of internal parasites to drugs is a growing world-wide problem. Integrated parasite control (IPC) including genetically resistant sheep seem to be a sustainable strategy in sheep production systems. FEC is a trait with a skewed distribution and logarithmic transformations are used to analyze the data. Its heritability is of the order of 0.25 to 0.30 under artificial challenge, and seems to be lower under natural challenge. Repeatability is of the order of 0.40. Protocols for measuring resistance of sheep to internal parasites have been developed but must be subject to further research. The relationship of FEC to production traits must also be clarified. There are ample research opportunities for the genetics of resistance to endoparasites in sheep, both in genomics and in breeding strategies. FEC and protocols for measuring resistance are areas in which ICAR could expand its research and development activities at the international level.

Key words*: health recording, drug resistance, genetic resistance, endoparasites, integrated control, fecal egg count.*

Resumen

Los caracteres relacionados con la salud animal han tenido limitada consideración por parte de ICAR. Los parásitos gastrointestinales son una carga muy importante para la producción ovina especialmente bajo condiciones de pastoreo extensivo. Un carácter importante es HPG (huevos por gramo de materia fecal) que se usa para medir tanto la resistencia de los helmintos a las drogas, como la resistencia de los ovinos

a los parásitos internos. Existe amplia evidencia de que la resistencia de los parásitos internos a las drogas es un problema mundial en aumento. El control parasitario integrado (CPI) incluyendo el uso de ovinos genéticamente resistentes, parece ser una estrategia sustentable para los sistemas de producción ovina. HPG es un carácter con una distribución asimétrica que requiere de transformaciones logarítmicas para el análisis de los datos. Su heredabilidad es del orden de 0.25 a 0.30 bajo desafío artificial, pero parece ser menor bajo desafío natural. La repetibilidad es del orden de 0.40. Protocolos para medir resistencia de los ovinos a los endoparásitos han sido desarrollados pero deben ser sujetos a más investigación. La relación entre HPG y caracteres de producción debe ser estudiada. Existen amplias oportunidades para la investigación de la resistencia genética a los endoparásitos en los ovinos, tanto en genómica como en estrategias de selección. HPG y protocolos para medir resistencia son áreas en las cuales ICAR podría expandir sus actividades de investigación y desarrollo a escala mundial.

Palabras clave: control sanitario, resistencia a las drogas, resistencia genética, endoparásitos, control integrado, huevos por gramo.

Introduction

The International Committee on Animal Recording (ICAR) has as its motto *quod scriptum est manet*, what is written remains, thus expressing the idea that modern animal production and its components like management, feeding, health and breeding are only possible to be conducted rationally and economically if proper recording is done. ICAR has long experience in recording production traits, and it has recently expanded its scope to include also some functional traits. Although recognized as very important, there has been however little progress in recording health related traits.

It would be far beyond the scope of the present paper to review the wide range of health related traits to consider as possible candidates for recording. The focus will be on fecal egg count (FEC) as an important health related trait in sheep. The case study presented here originates from an FAO technical cooperation project on genetic resistance to gastrointestinal nematodes in sheep, conducted by the Uruguayan Wool Secretariat (SUL) and the Uruguayan Veterinary Services (DILAVE). This paper will also include a general description of the problem and some related results from experiences in other countries.

The problem

The vast majority of sheep in the world are raised under grazing conditions and are subject to internal parasites. The most common and important internal parasites affecting sheep in temperate South America - in this case Uruguay - are: *Haemonchus contortus*, *Trichostrongylus spp.*, *Ostertagia spp.*, *Cooperia spp.*, and *Nematodirus spp.* The measurement of

resistance requires diagnosis and adequate recording. Two types of resistance must be considered: resistance of sheep to internal parasites and resistance of internal parasites to drugs (Box 1).

Box 1.
Two types of resistance to be considered

- **Resistance of internal parasites to drugs.**
  depends on the genetics of the parasite, it arises from selection pressure due to the use of anthelmintics, it is a growing problem, it has reduced options in drugs.

- **Resistance of sheep to internal parasites.**
  depends on the genetics of the sheep, it is basically a polygenic trait with medium to low heritability, with selection programs for resistance to gastrointestinal nematodes being conducted, some breeds have naturally higher resistance.

Resistance of internal parasites to drugs

The continuous and intensive use of drugs has resulted in high frequency of resistant gastrointestinal nematodes all over the world, according to an FAO survey (Nari and Hansen, 1999). This study was conducted mainly to determine the importance of the problem of resistance of ecto- and endoparasites to the most commonly used chemical compounds. The definition of resistance used in the report is the detection by sensitive tests of a significant increase of individuals of one species and population of parasites that are capable of tolerating doses of drugs proven to be lethal for most individuals of the same species. The main conclusion of the study is that 86% of 77 OIE (*Office International des Epizooties*) member countries, representing 52% of membership, have reported the occurrence of resistance to anthelmintics.

During the past decade this problem has been given increasingly more importance, but its control has not been altered substantially. Countries taking some measures to prevent parasite resistance to drugs do so almost exclusively by rotating or changing antiparasitic agents. The situation is worsened by the fact that no permanent supply of new drugs is foreseen (Nari and Hansen, 1999) due to high cost of research, long development time to reach the market, and the existence of more profitable areas for drug development, like drugs for human use. In many parts of the world

veterinary services are no longer a totally public service, have lowered their vigilance status, and do not have the means or infrastructure necessary to carry out tests for drug resistance. Therefore, the fact that a country has not reported resistance does not mean that it does not occur. However, there seems to be a trend towards less frequency of resistance of internal parasites to drugs in countries with low or no use of anthelmintics.

A survey conducted on 252 farms randomly distributed over the sheep raising areas of Uruguay and representing 80% of the total sheep population of the country (Nari *et al*., 1996) concluded that in 92% of sheep farms in Uruguay some degree of resistance to anthelmintics exists. The drug groups tested were benzimidazoles, levamisole and avermectins (Table 1). In many cases multiple resistance was detected: 28% of farms showed resistance to one anthelmintic group, 64% to two anthelmintic groups and 1% to all three groups tested.

Table 1. Anthelmintic resistance in sheep nematode parasites in Uruguay (Nari et al., 1996)

	Percentage resistance		
	Benzimidazoles	Levamisole	Ivermectin
Trichostrongylus	91.7	95.0	0.0
Haemonchus	61.3	28.5	1.2
Ostertagia	18.4	12.8	0.0

The lack of response of a flock to anthelmintic treatment does not necessarily mean that there is a resistance problem. After other possible causes have been discarded, a test for anthelmintic resistance (Nari, 1987) can be conducted based on measurements of reduction in FEC (RFEC), as summarized in Box 2. Groups of at least 10 animals each from the problem flock are formed. There will be two basic groups: non treated control (C) and trated with the problem drug (T). There may be additional groups formed with sheep from the same problem flock; for example, animals treated with a different product, other means of administering the drug, or given different doses. During the test all animals must be in the same paddock under the same rearing conditions. The sampling of fecal mater has to be done individually at day=0 and day=10 after treatment. All animals have to be kept in the collective pens the same amount of time so as to be equally affected by the fasting period conducted previous to the test. If any statistical analysis is to be valid, egg counting techniques must have at least a sensitivity of 50 eggs/g and there must be an acceptable realized repeatability of measurements. The nematode

species can be ascertained by an identification of larvae in pools originated from the different groups. The raw FEC data are generally transformed logarithmically (Box 2) and the RFEC is then calculated by the formula: RFEC(%) = [1-T2/T1 x C1/C2] x 100, where C and T are the geometric means of the control and treated groups respectively, and 1 and 2 identify the FEC measurements done respectively at day 0 and 10 post-treatment. Arbitrary values of less than 95% are taken as indicating anthelmintic resistance. Confirmation is further sought by autopsy on 2 to 4 animals in each group, 10 to 14 days after treatment. Possible next steps are in-vitro experiments using reference strains and experiments with controlled infestation.

Box 2. Protocol for determining drug resistance (Nari, 1987).

Determination of resistance
Measurement: reduction in FEC
Field experimental design (standard)

- Control sheep=C (N>10).
- Drug treated sheep=T (N>10).
- Sample at day 0 (C1 and T1).
- Sample at day 10 (C2 and T2).
- Autopsy at day 14 (N=3).
- RFEC(%) = [1-T2/T1 x C1/C2] x 100
  (C, T = geometric means).
- RFEC < 95% indicates likely resistance.
- *In vitro* experiments with reference strains.
- Controlled infestation.

How does selection for parasite resistance to drugs work? The enormous reproductive potential of the parasites and the repeated use of drugs will increase the frequency of genes for resistance in the parasite populations. The genetic basis of this resistance is still not well known, and it may be due to polygenes or quantitative trait loci (QTL), and also to the action of single major genes. The parasite cycle involves two sub-populations: the parasitic phase population and the free phase population which includes eggs and larvae in three stages (L1, L2, L3) and that is not affected by anthelmintics. Both populations are interdependent and connected through contamination rates from animals to pastures, and contamination rates from pasture to animals. The efficiency of the selection process towards parasite resistance to anthelmintics will depend

on the drug (type, dose and method of application) and on the environmental conditions (pasture, season, weather conditions, flock management). For example, many individuals of the free parasite sub-population may be lost due to exposure to sun, heat, dry conditions, predators, or simply because they did not reach the appropriate host.

Preventive measures against the development of nematode resistance to anthelmintics have been recommended. They include less frequent use of anthelmintics or their differential use in highly infected animals, the use of drugs with reduced spectrum, high doses as to ensure total kill, the use of anthelmintics of different groups in slow rotation, the alternate use of drugs with high and low spectrum (wormkill) and, probably the most efficient and logical strategy, the so called integrated parasite control (IPC). This last one is based on the use of a combination of prevention and parasite control measures: high nutritional levels (well fed sheep are more resistant), strategic use of drugs (this requires good professional guidance), pasture management (to decrease contamination) which includes alternate grazing of different species (cattle and sheep) and grazing by age groups (young sheep are less resistant to parasites). Methods of biological control, for example a fungus that predates on parasite larvae, are being developed but their practical use is still in the experimental phase. Finally, another component that is sought as part of helminth IPC is the genetic resistance of sheep to internal parasites. A parallel reason to think of genetic resistance of sheep to parasites as a major component of IPC is the realization that chemical residues of antiparasitic drugs may accumulate in the tissues of host animals or in products like animal fibers like wool and hair, and hides. This may be detrimental both for human health and for international trade.

Resistance of sheep to internal parasites

Time old field observations indicated that there are individuals within a flock that show more resistance to internal parasite infections. This has led to experiments to study the distribution and genetic parameters of sheep resistance to helminths, and to possible selection plans for this trait within populations. The same type of observations has been made over many breeds, ascertaining that there are breeds that seem to be more resistant to internal parasites than others. There are therefore two main lines of research in the area of sheep resistance to internal parasites, namely seeking breeding for resistance within breeds (Woolaston and Baker, 1996) and the study of resistant breeds (Baker, 1998).

The main within breed selection strategies have been: selection for resistance, selection for resilience, and selecting for reduced number of treatments (Woolaston and Baker, 1996). Resistance is defined as the ability of the host to initiate and maintain responses to suppress the establishment of parasites and / or to eliminate the parasite load. Resilience is the ability of the host to maintain a relatively undepressed production level under parasite challenge. Selecting for a reduced number of

treatments relies on the ability of breeders to detect those animals that require more treatments, and treating them differentially as to achieve good production levels. This last strategy seems rather difficult to apply in practice, especially under extensive grazing conditions. The choice seems therefore to be between selecting for resistance or selecting for resilience, although probably both traits are genetically correlated. For conceptual reasons based on the physiology of the relationship between host sheep and parasites, and the evidence that the heritability is higher for resistance, this trait has been the preferred selection strategy. The selection criterion used is FEC. The average heritability of FEC over many studies and populations is 0.25 and the average repeatability 0.35. However, analyzing data from Uruguay, Swan (2001) obtained preliminary estimates of 0.09 and 0.27 respectively. This may be an indication of lower genetic parameters due to more environmental variation under the extensive grazing conditions of temperate South America, or also due to the fact that natural parasite challenge was used instead of artificial challenge. This last type of challenge is under better experimental control and is supposed to achieve higher FEC heritabilities and repeatabilities.

There are important between breed differences in resistance to internal parasites in sheep. Many studies have been and are being carried out for identifying and characterizing this resistance, of which two recent ones are mentioned as examples (Baker *et al*., 2001 and Rege *et al*., 2002). It is not the scope of this paper to review these studies. One of the basic ideas that represents a logical work hypothesis is that over time different breeds have evolved different mechanisms for resistance. At a later stage, by crossing resistant breeds a synthetic population of highly resistant sheep can be obtained.

Fecal egg count as measurement of resistance

Resistance cannot be measured directly. FEC is a good indicator trait and can be used as the selection criterion for resistance (Baker, 1998). It has been suggested that counting techniques should use improved sensitivity McMaster, since one egg in the counting represents 50 eggs / g upon extrapolation from the sample to the animal. Diverse protocols have been proposed. The Milk and Livestock Commission of the UK (MLC) in association with CBS Technologies, UK (Nieuwhof and Evans, 2002) does sample at scanning (20 weeks) plus 4 weeks no deworming. The logistics include labelled bags, and data quality and checks by controlling FEC within flock mean and variance. The International Livestock Research Institute (ILRI) has extensive experience in the area of measurement of sheep resistance and uses similar protocols for FEC (Baker *et al*., 2001; Rege *et al*., 2002).

The Commonwealth Scientific and Research Organization, Australia (CSIRO, 1992) utilizes a standard operating procedure (CSIRO SOP No. PR / 02) for sheep management during worm challenge, which has been

adopted by the FAO sheep resistance project in Uruguay (Swan, 2001). It states that during worm challenge sheep should be managed in such a way as to minimize pasture contamination. Then to monitor the health of the animals so that the infection, either artificial or natural, does not compromise the welfare of the flock. All the sheep in the flock are drenched prior to artificial infection, using a chemical that will kill all the parasitic nematodes present, e.g. Ivomectin. Sheep are then infected with a known dosage of stage III larvae of the required worm species. The day of infection depends of the clean up drug used. With Ivomectin, currently recommended by the CSIRO laboratories as a clean up drug, sheep should not be infected within 7 days after drenching. The dose of larvae depends on factors such as the species of worm, age and size of sheep, pasture conditions, body condition of sheep and the length of the planned infection. For example, for *Haemonchus contortus* it is recommended to carry out infections of 10000 larvae per head for a 3 to 4 week challenge. Sheep can be run under normal conditions for the first 18 days of the infection, after which time the larvae will have reached maturity and begin laying eggs. From this time on the pasture will be contaminated with large numbers of eggs and larvae. At the completion of the fecal sampling, the sheep should be drenched with a drug appropriate to the parasite species used in the challenge, leaving them 24 hours before moving them to a fresh pasture.

FEC has an asymmetrical distribution (Figures 1 and 2) with significant indexes of skewness and kurtosis. A logarithmic transformation is performed on the data to allow statistical analyses that rely on a normal

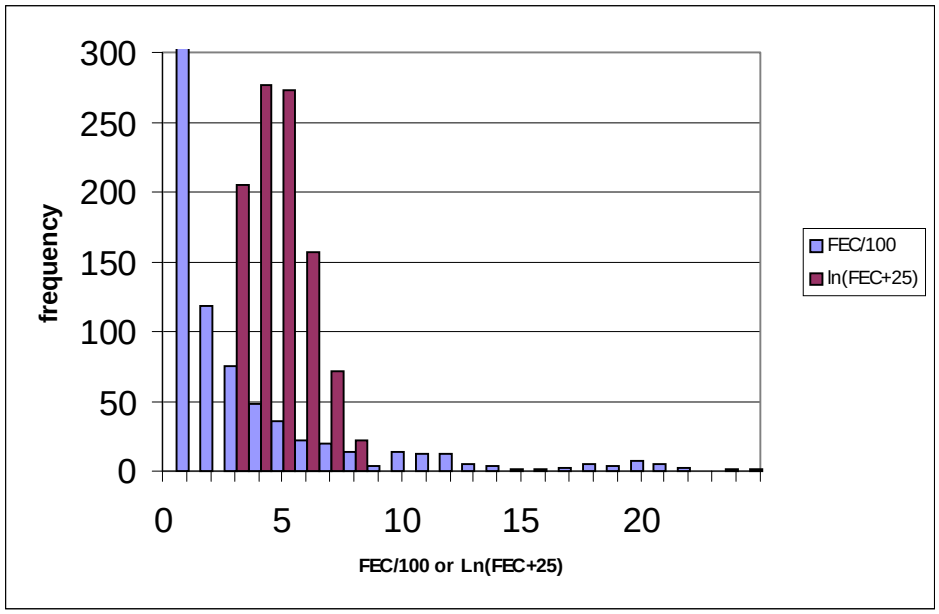

Figure 1. Example of the phenotypic distribution of fecal egg count in sheep in the UK (Nieuwhof and Evans, 2002).

distribution of observations (Figure 1). Nieuwhof and Evans (2002) found an average variance of Ln (FEC+25) = 1.1 also using in practice a heritability value h^2 = 0.30. Genetic correlation (r_g) with production traits is considered very low but negative (-0.1), as well as phenotypic correlation (r_p) with production traits (-0.05). Expected breeding values (EBV) are not additive but multiplicative, ranging from -0.7 to +0.7. An EBV= -1 represents 37% less eggs as compared to EBV=0 and on the other extreme an EBV = +1 represents 2.7 times as many eggs as the base EBV=0.

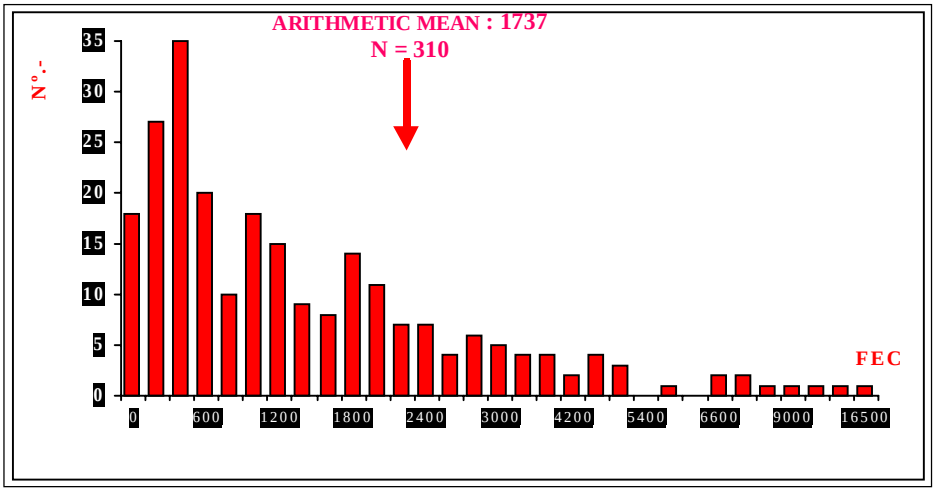

Figure 2. Example of the distribution of fecal egg count in sheep in Uruguay.

Conclusions and recommendations

Resistance of internal parasites to drugs is both a global problem and a growing problem. It has to be addressed immediately since the options for available and effective new drugs are getting narrower all the time. There are also environmental and human health implications to a worldwide increase in the use of drugs. Integrated parasite control (IPC) based on the use of a combination of prevention and parasite control measures like high nutritional levels, strategic use of drugs, pasture management, including alternate grazing of different species and by age groups, is justified as a sustainable strategy. It is recommended that research efforts be directed towards the study of FEC as a trait to measure resistance. This includes biological aspects, for example, what FEC is really measuring from a physiological and production point of view, as well as statistical aspects like distribution of the trait and better ways to handle data analysis. Another area for research is the development of protocols for internal parasite challenge experiments considering the wide range of species of internal parasites and host species and breeds, and a range of environments. The genetics of resistance, both resistance of sheep

Box 3. Conclusions and recommendations

- Drug resistance affects almost all countries.
- Integrated control of gastrointestinal parasites is a sustainable strategy.
- There are research needs concerning:
  1) FEC as resistance measurement trait.
  2) Protocols for internal parasite challenges.
  3) Genetics of resistance (sheep & parasite).
- ICAR should consider FEC and resistance measurement protocols.
- FAO should support breeding strategies for resistance to gastro-intestinal parasites in sheep.

to gastro-intestinal parasites, and resistance of nematodes to anthelmintics is a wide area for research to contribute to practical solutions. The first type of research may include the genomics of resistance by mapping single genes or QTLs, functional genomics by trying to discover how genes work to make animals or breeds resistant to internal parasites, breed comparisons, the determination of genetic parameters like heritabilities for FEC and related traits, and genetic correlation of FEC with production traits, and genotype x environment interactions. Box 3 summarizes the main conclusions and recommendations. From an institutional point of view, ICAR should consider FEC and resistance protocols among its areas for future involvement and FAO should support projects that include breeding strategies for resistance to gastro-intestinal parasites in sheep.

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Milk recording under different production systems in Egypt

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Summary

The paper shortly presents data of the cattle and buffalo population in Egypt, where the dairy sector contributes for about 1/3 of the national agricultural production; no milk records are kept for small farm or medium herds. The head number together with distribution and herd sizes are outlined. Production data for milk in cattle and buffalo are also reported

A programme for animal recording data started in 1989 in order to establish a cattle information system (CISE) is then described; the results reported that include herd summary, information on individual animals and priority lists. Such reports are published on a monthly basis.

Milk production in Egypt is based either on the traditional crop / livestock system or on the (intensive) industrial production system Within CISE activities, personnel have been trained and statistical facilities have been developed. The recording scheme is based on visits on a monthly base (ICAR A4-method) and data are recorded on a single input-sheet for every animal. Data are then analysed with the Canadian Record of Performanc (ROP) and DHIS, IDEAS and LIMS from ILCA.

Constrains can be distinguished in structural, cultural and educational, technical and financial origin. Recommendations to overcome such limits are briefly described.

Introduction

In Egypt the dairy sector contributes about 30% of the total value of agricultural production. The population of dairy animals is about 6.7 million heads of cattle and buffaloes. The total milk production is about 3.6 million tons (Ministry of Agriculture and Land Reclamation, MALR, 2000).

Table 1. Cattle and buffalo population (in million).

	Number (million)	%
Cattle		
Native	2.373	35.0
Foreign purebred	0.133	2.0
Crossbred	0.912	13.5
Total cattle	3.418	50.5
Buffaloes	3.330	49.5
Total	6.748	100.0

Source: Animal Production Sector, MALR, 2000.

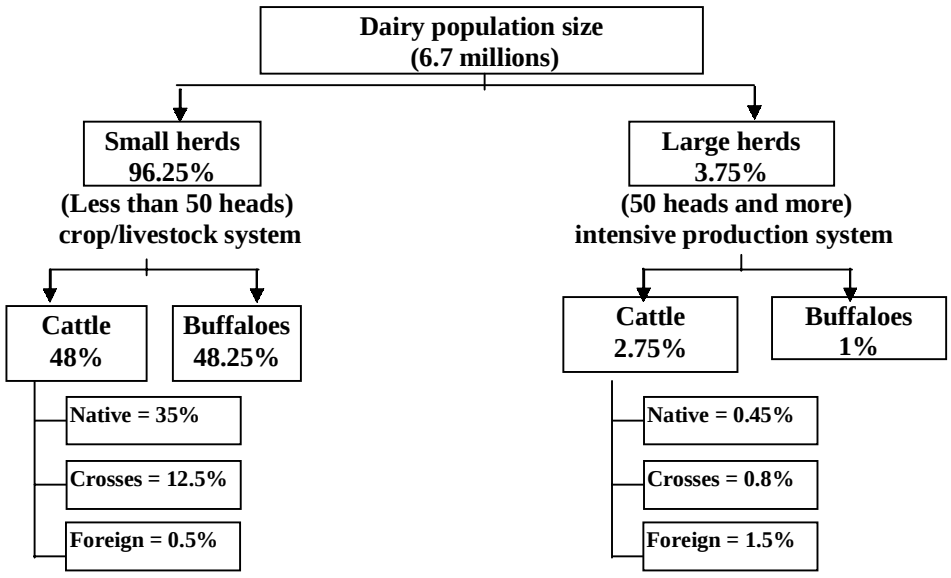

Figure. 1. Distribution of cattle and buffalo populations over the two major production systems.

The two major milk production systems in Egypt are the traditional crop/livestock which holds about 96% of the cattle and buffalo population and the "industrial" intensive production system which contains large commercial farms of more than 50 heads each, mainly of high yielding foreign breeds of cattle. Another system includes medium-size buffalo flying herds at the outskirts of large cities for milk production.

Table 2. Distribution of cattle and buffaloes by herd size.

Herd size (head)	No. of buffaloes	No. of cattle	Total
Less than 10 heads	2 899 809	2 830 881	5 730 690
	(43%)	(42%)	(85%)
(No. of holders = 1 687 986)			
10 – 24 heads	279 339	319 749	0 599 088
	(4.1%)	(4.7%)	(8.8%)
No. of holders = 45 021			
25 – 49 heads	84486	81275	165761
	(1.25%)	(1.20%)	(2.45%)
No. of holders = 7 194			
50 heads and more	66 066	185 672	251 738
	(1%)	(2.75%)	(3.75%)
No. of holders = 1166			
Total	3 329 700	3 417 577	6 747 277
	(49.35)	(50.65%)	(100.0%)

Source: Animal Production Sector, MALR, 2000.

No milk records are kept in small farms or medium and flying herds. Most experimental farms keep records for management and research purposes. Large commercial farms apply computerized dairy management programs for controlling farm activities and decision making.

The objective of this presentation is to discuss the on-going milk recording activities under different milk production systems in Egypt, with a especial attention to the constraints facing the establishment of a national milk recording system.

Table 3. Milk production from cattle and buffaloes.

	Milk production (Million tons)	% of the total production
Cattle		
Native	0.544	15.0
Foreign purbreds	0.274	7.5
Crossbreds	0.778	21.5
Total cattle production	1.596	44.0
Buffaloes production	2.018	56.0
Total production	3.614	100.0

Source: Animal Production Sector, MALR, 2000.

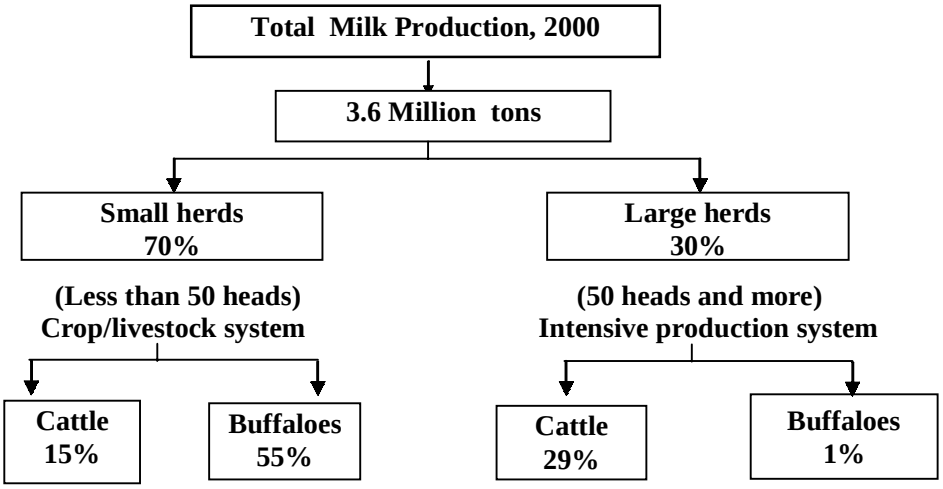

Figure 2. Milk production by the two major systems.

Background information

From the published data of MALR 2000, cattle and buffalo populations for all Egypt are summarized in Table 1. The distribution of cattle and buffaloes over the two major dairy production systems is shown in figure 1. Table 2 explains the distribution of cattle and buffaloes by herd size.

The population of dairy animals is divided almost equally between cattle and buffaloes. The importance of the small proportion of foreign breeds comes from their significant contribution to the regular milk market and dairy processing plants.

Concerning age structure, the mature females of cattle and buffalo (> 2 yrs.) represent 45% and 50% of the total cattle and buffalo populations, respectively. The higher percentage of mature female buffaloes confirms the recognition of the buffalo by the farmer as the major dairy animal in Egypt.

According to the 2000 MALR published statistics, the total milk production from cattle and buffaloes is about 3.6 million tons (Table 3). About 55% of the total milk output comes from buffaloes. Buffalo milk is preferred by Egyptian consumers because of its white color, high fat content (about 7%) and flavor. The contribution of foreign breeds and crosses to the domestic milk production is about 30% which is produced mainly by commercial farms. Figure 2 shows the contribution of buffaloes and cattle to total milk production.

In 1989, the Animal Production Department, Faculty of Agriculture, Cairo University started a pilot project financed by the International Development Research Center (IDRC), Canada to establish a “Cattle

Information System in Egypt (CISE)". Village Extension workers (VEW's) from the MALR were trained as field recorders, and the university staff and postgraduate students as supervisors. Data were collected based on once-a-month visit, and monthly reports were issued by CISE and sent regularly to each enrolled farm. To encourage farmers to join the programme, a package of technical services, on cost recovery basis, were offered to farmers by CISE (concentrates, veterinary services, pregnancy diagnosis, treatment of infertility cases … etc.).

In 1996, the project was transferred into a special self financed non-profit community service center. The center has well trained personell and owns well equipped network for data collection, analysis and evaluation. CISE produces monthly reports for farmers which include:
1) herd summary;
2) information on individual animals; and
3) an attention list to help in farm management.

A Technical Cooperation Program (TCP) between MALR and FAO was designed in 1996 to expand CISE program to a National Dairy Herd Improvement System in Egypt (DHIS). The document of the National DHIS nominated CISE as the National Central Data Processing Laboratory in Egypt.

CISE succeeded in gathering the facilities of relevant institutions to implement a national milk recording program in nine governorates. CISE is currently a member of ICAR and follows its guidelines in milk recording.

Dairy production systems

There are two major milk production systems in Egypt:
1) The first system is the traditional crop / livestock system which is traditionally integrated with the dominating agricultural system. It contains about 96% of the cattle and buffalo population and produces about 70% of the total domestic milk output. This system is characterized by:
   - Small holdings and herds (1-5 heads / farm) of low producing native animals.
   - Labor intensive operations using simple techniques and practices.
   - No recording for milk or for any other activities.
   - Low values of inputs and outputs.
   - Surplus milk is sold at farm gate to middlemen at low price, and live animals are sold alive in village markets.
   - Most services have been provided to the farmer by the MALR free of charge, but recently a cost recovery basis has been applied to some services.
   - The farmers families are the primary consumers of the milk, and, therefore, the contribution of this system to the regular milk market does not match its large population size.

2) The second system is the (intensive) industrial production system which contains large commercial farms of more than 50 heads each, mainly of high-yielding foreign breeds of cattle. Commercial farms contain about 4% of the total cattle and buffalo population but produce about 30% of the marketable milk. Milk recording in most of these farms are conducted through computerized dairy management programs used mainly for controlling and operating farm activities and supporting decision making. Large scale farms belong either to specialized companies, cooperatives or privately owned. Some large companies have their dairy processing plants and feed mills. Most large dairy farmers are members of the General Cooperative for the Development of Animal Wealth located in Cairo, or/and other associations such as those of the Egyptian Buffalo Producers' Association (EBPA) or Egyptian Milk Producers' Association (EMPA).

3) A minor type of farms is operated under a strictly commercial milk production system contains relatively smaller buffalo farms located at the outskirts of large cities. In this system, buffaloes are put under very intensive feeding regiemes to produce high-fat milk which is delivered directly to consumers. Buffaloes are bought in milk and are sold for slaughter immediately after drying off. Through this system, much of the best animals are lost. Recently, attention has been focused on identifying and selecting high yielding buffaloes to purchase them and formulate nucleus herd(s) for the purpose of genetic improvement of milk in buffalo herds.

4) There is no specialized beef breeds in Egypt, meat is produced either by native cattle or buffaloes, or by imported feeders and ready to slaughter steers.

In the traditional system, native calves are sold alive either when cash is needed or when they are culled. Buffalo calves are sold for slaughter at a very young age to save their dams' milk for family consumption. Farmers and feedloot operators were encouraged by soft loans provided through the National Veal Project, to keep buffalo males for a longer period to attain higher body weights.

Current situation of milk recording

Organizations

Variable activities are undertaken for milk recording in Egypt. Almost all experimental farms have milk records to control its operations and help decision making. Some of these farms own computerized farm management programs. The large commercial dairy farms operates varied types of farm management programs. Animal Production Research Institute (APRI), MALR provides service package (complete milk analysis, somatic cell counting and feed treatments to enrich roughage nutritional value) to the dairy farms. In the meantime, APRI measures daily milk production during a once-a-month visit to the enrolled farms.

In general, the outputs of the abovementioned recording activities are not uniform enough to be exploited in effective breeding program. CISE is currently operating a national milk recording program in nine governorates. CISE was established in 1989 as a pilot project financed by the IDRC of Canada to act as the cattle information system of Egypt. It was transferred in 1996 into a self financed non profit community service center. CISE is the member of ICAR and follows its recording guidelines both in cattle and buffaloes.

Facilities

Scattering facilities needed to establish a national milk recording exist in Egypt. For example, APRI has an effective service package as mentioned above. Animal Production Sector has a network of VEW's spread almost at all villages in the country. There are major associations for animal breeders. The General Cooperative for Development of Animal Wealth (GCDAW), the Egyptian Buffalo Producers Association (EBPA) and the Egyptian Milk Producers Association (EMPA). Most of the dairy farmers are members in one of these associations.

CISE has well trained specialists and well equipped statistical laboratory (hard –and software) capable to analysis up to 100 thousand records of enrolled animals. Also, the center has equipment for fat test, mastitis detection and early pregnancy diagnosis.

Despite the presence of all elements needed for milk recording, the links and coordination among relevant institutions is not strong enough. CISE is working on institutionalizing the relationships among organizations interested in animal recording.

Methodology

The CISE milk recording scheme depends on once-a-month visit (official 24-hour milk recording system, ICAR A4-method). An official recorder collects the data on farm at a specific day "centering date" identified by CISE. Due to the lack of a national identification program, animals on small or medium scale farms are identified by plastic eartags provided by CISE. Animals on the large scale farms are identified by the owner identification marks (plastic or metal eartags, ear tattooing and sometimes by liquid nitrogen branding). The data processing system is working with the Input-Sheet number as the animal identification key.

Data collection

The VEW's visit farms and measures milk yield during the normal milking times on the testing date. Simple balances are used on the small farms but electronic milk meters or milk jars are available on large farms. Data

are recorded on a single Input-Sheet specific for every animal. The following information is recorded: milk yield, animal status, insemination information, pregnancy diagnosis and calving information. The input-sheets are transported by the recorders to the data processing lab (CISE).

Data entry and analysis

Based on the Canadian Record of Performance (ROP) and DHIS programmes, IDEAS and LIMS from ILCA, and German experience in milk recording. CISE has developed its own software in Arabic for data entry and analysis for both cattle and buffaloes. The CISE software takes care of the specific conditions of the small herds and the characteristics of local breeds, especially buffaloes. An Arabic monthly technical report is issued directly to farmers which contains three parts: herd summary, individual information and attention list. The herd summary contain: averages of daily milk yield for both recorded and lactating animals. The individual cow information contains: reproductive information, total milk yield, days in milk and expected 305 day milk yield. The attention list shows the cows which are still non-pregnant, animals due for service, due for palpation, and due for drying off…etc.

Recently, the technical report includes the results of milk fat test, pregnancy diagnosis and mastitis detection. For small farmers, small village farms are treated as one herd. The report is supported by extension work at the village level.

Services

Two different service packages are offered –on cost recovery basis- to both of small holders and commercial medium farms.

a) The following services are provided by CISE to the small farmers:
   - Milk processing using separators and churns.
   - Chopping crop residues for utilization as animal feedstuff.
   - Machine milking by small portable machines.
   - Provision of good quality concentrates.
   - Veterinary services.

b) Recently, for medium-sized commercial farms, CISE provides fat test, pregnancy diagnosis using sonography, and mastitis detection during the monthly visit.

Constraints

The constraints for establishing the national milk recording system in Egypt can be summarized as follows:

a) Structural constraints:
   - Scattering of animals (small herds of less than 10 heads represent about 85% of population).
   - Inefficiency of the existing Breed Associations.
   - Absence of coordination among relevant institutions.
   - Absence of a national identification and registration program.

b) Cultural and educational constraints
- High illiteracy rates.
- Adverse traditions, and beliefs.
- Small farmers keep animals mainly for food and/ or financial security.

c) Technical constraints
- Absence of breeding programs.
- Inefficiency of extension services.

d) Financial constraints
- Small farmers are not able and are not willing to pay fees for milk recording.
- Few commercial farmers only pay the actual cost.
- Recording cost is high due to the limited enrolled herds.

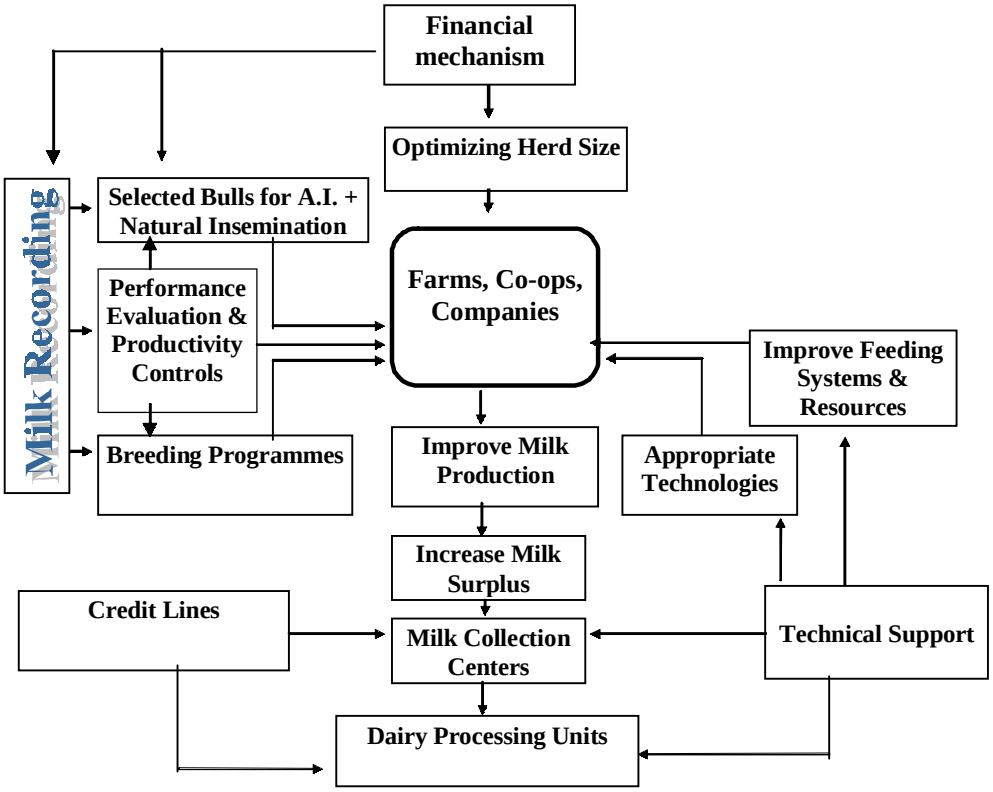

Figure. 3. The role of milk recording in improving the efficiency of the dairy sector.

Recommendations for the development of the dairy sector

a) Resources development:
- Optimizing herd size.
- Setting breeding objectives and programs.
- Attaining international standards of production.

b) Organization:
- Expanding the activities of the animal dairy specialized farms & co-operatives.
- Strengthening existing service schemes.
- Strengthening links and relations among institutions responsible for milk recording.

c) Systems:
- Developing identification and registration program.
- Encouraging the concept of milk recording.
- Encouraging market-oriented milk production.

d) Finance:
- Establishing financial polices for sustainable milk recording.
- Establishing citeria for collateral and loan systems for large dairy operations.

Figure 3 shows the role of milk recording in increasing the efficiency of the dairy sector.

Recent research in milk recording under Egyptian conditions

In order to overcome the constraints to improving milk recording in Egypt, many recording schemes were developed to decrease cost, time and efforts of recording. In this direction, once-a-month, bimonthly and trimonthly recording schemes have been studied, especially to fit the small farmers' conditions, who reject receiving foreigners (milk samplers and data collectors), frequently at their homes.

Sadek *et al.* (1994) and Abou-Bakr (1996) and Abdel-Aziz (1996) concluded that once-a-month milk recording system could be applied for estimating total milk yield, genetic parameters and breeding values of Egyptian buffaloes with a high accuracy (r^2= 0.98) .

Hamed (1995) and Abou-Bakr (1996) tested the use of bimonthly and trimonthly milk recording systems in estimating total milk yield in Holstein and buffaloes. They found that the accuracy of estimation ranged between 0.79 and 0.95.

Abd El-Lattef (2002) studied the use of different milk recording schemes (AM-milking, PM-milking, alternative AM / PM and alternative PM / Am) under monthly, bimonthly and trimonthly recording systems in estimating milk yield in buffaloes. The conclusion was that, the AM-milking, alternative AM / PM and alternative PM / AM schemes under monthly, bimonthly and trimonthly recording schemes could be utilized in estimating total milk yield, heritabilities and breeding values for Egyptian buffaloes with reasonable accuracies.

Table 4. Enrolled animals.

Governorates	No. of herds	No. of animals	No. of records
Giza	28	2 195	4 858
Ismailia	5	622	1 244
Gharbia	3	98	196
Beni-Suif	18	220	399
Fayoum	1	580	1 221
Behaira	9 (villages)	477	1 271
Sharkia	2	194	390
Kalyobia	2	254	466
Alexandria	1	930	1 808
Total	70	5 570	11 553

Table 5. Milk production characteristics.

Production system	No. of records	TMY (kg)	LP (day)	DMY (kg)	Actual 305 d (kg)	Fat (%)	CI (day)
				Cattle			
Commercial:							
Holstein (H)	3 037	8 280	360	23.0	7 650	NA	450
Friesian (F)	183	6 805	317	21.5	6 600	3.5	380
(H x F)	3 537	7 040	337	20.9	7 005	3.3	425
Experimental:							
(H x F)	50	6 830	340	20.1	6 780	3.3	429
(F x B)	614	2 445	325	7.5	2 340	3.8	413
Traditional:							
Baladi	210	1005	230	4.4	1 005	NA	395
				Buffaloes			
Commercial:	2 334	2 105	305	6.9	2 105	6.9	415
Experimental:	340	1 560	270	5.8	1 560	8.0	420
Flying herds:	842	2 750	370	7.4	2 390	NA	495
Traditional:	664	1865	330	5.7	1 815	NA	435

TMY= Total milk yield; LP= Lactation period; DMY= Daily milk yield;
CI= Calving interval, B= Baladi cattle and NA= not available.

On-going activities of CISE

1) *Enrolled animals.* A total number of 5570 animals (cattle and buffaloes) distributed over 70 herds in nine governorates under different production systems are enrolled (Table 4).
2) *Provision information on local and foreign dairy animals* under different production systems. Milk Production and calving interval (CI) for cattle and buffaloes under different production systems are shown in Table 5.
3) Buffalo improvement program. Special attention has been given to buffaloes, as the major dairy animal in Egypt. A milk recording program was initiated since September 2000 by CISE for buffalo herds under different production systems in eight governorates. The objectives of this program were:
   - Recording milk production of large number of buffalo farms.
   - Identifying elite buffaloes.
   - Establishing a nucleus herd.
   - Building a database to benefit farmers in:
   - purchasing and establishing new herds.
   - providing pedigreed bulls and potential breeding heifers.
4) *Establishing buffalo nucleus herd(s).* Preliminary analysis of milk records of 2065 buffaloes in 58 herds under different milk production systems in eight governorates enabled the specialists at CISE to identify the elite milking buffaloes. About 20% of the enrolled buffaloes produce over 2000 Kg of milk in an average lactation period of 314 days, which is significantly higher than the national buffalo average.
   Nucleus herd(s) of selected buffaloes will be formulated, where buffaloes are kept for further genetic evaluation. The nucleus herd(s) are expected to produce good heifers for replacement at buffalo dairy farms, and pedigreed young bulls for breeding purposes.

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Needs for research and development in Livestock Recording Systems (LRS) in transition and developing countries

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Summary

One of the constrains of the Livestock Recording System (LRS) is related to structural problems in the livestock sector and its institutions. Within different production systems, the necessity of standardising LRS is stressed; the more developed is the country the higher are the inputs for producing meat with the desired quality. In transition countries production systems are different and contacts among the various elements of the productive chain are less tight; this is due to the stage of development of the national economy and the physical and institutional infrastructure.

An efficient LRS should satisfy the information needs, ensure the interest of the owners by providing a co-operative environment, incorporate various stakeholders and fix an operational and financial dimension.

The various interdependency of LS and LRS purposes are shortly described and information linkages for decision-making and programme implementation are summarised. In order to facilitate transition countries in their modernisation process, the various elements involved in the recording process are analysed, i.e. sampling procedures to get representative data and phenotypic information, minimal information standards to reach affordable objectives, setting breeding goals, establish an identification system to overcome owners resistance and evaluate performance assessment

Introduction

To date LRS are widely recognised as part of information systems in the agricultural sector with the objective to improve the efficiency of the livestock system and farm operation. LRS do pursue different purposes such as improvement of animal performance, herd and farm management, product quality and sector policy. Decisions at all levels do require analysable information to meet the objective of improving

productivity and efficiency. Thus, under more intensive production conditions of market oriented Livestock Systems (LS), LRS are essential and highly effective tools in system development (Flamant, 1998; James, 1998; Meyn *et al.*, 2001).

Despite the proven benefits of LRS and the ever advancing effectiveness, the application of LRS in regions with evolving economies and less intensive livestock systems remains a problem and an issue of major concern to Researchers and Developers.

Majors problems seem to be associated with
a) low awareness of potential benefits of recording to livestock owners, the Research and Development (R+D) sector and policy makers,
b) problems of finding the right organisation for animal recording and of attaining due participation,
c) lack or insufficient technical know-how to implement and utilise recording, and
d) lack of or non-sustainable funding to cover the cost of LRS (Trivedi, 1998).

This paper attempts to contribute to the identification of R+D with a focus on LRS in different LS, its purposes, organisational needs, recording methods and cost effectiveness.

Assessment of needs in LRS

One of the dilemmas of LRS in evolving livestock systems is related to structural problems in the livestock sector and its institutions. Disciplinary boundaries and institutional barriers between relevant agents involved in policy making, development of concepts and implementation of tasks in livestock policy analysis, farm management improvement and service, breeding policy and program implementation, veterinary services often restrain the definition of shared objectives and purposes related to LRS. Moreover the linkage between Research and Development agents and their staff, and the participation of livestock owners is far from being optimal.

Thus, the pursuance of partial objectives and the definition of self-centred needs can contribute to the rather unsatisfactory experiences of LRS (Flamant, 1998).

The system context for LRS

The identification of objectives, purposes, tasks of LRS, and implementation requires a close association with the livestock system it is supposed to serve. Different systems demand different objectives and purposes, and as such require different tasks, approaches and recording methods.

Livestock systems (LS) undergo a dynamic development in relation to the macro economic conditions and changes in factor costs. Three such stages are described and compiled in table 1. At a stage of low market contact and high capital cost LS tend to be diversified, rely on household resources and have the major objective to attain food security, contribute to family insurance, and reduce risk. Improvement options are limited due to the scarcity of input factors, the prevailing production risk, and limited output options.

Under conditions of increasing market linkages and external inputs the livestock enterprise reduces the number of functions and objectives it serves in the system, and tends to specialise. First decisions for reducing diversity have to be made and the livestock system is gradually oriented to market opportunities. Options for improving livestock performance and management initially depend on the availability and cost of inputs, but increasingly on skills and information. Proximity to supporting infrastructure, institutional support and secure market opportunities foster this system development and the need for improving system efficiency.

A growing market demand for specific livestock products and the associated demands for product quality together with the need to increase labour and land productivity will lead towards a more specialised livestock system with a growing input of capital for yield increasing and labour saving technologies. Growing external inputs (investments) increase production risks and demand all measures to maintain and improve productivity and efficiency.

Many livestock systems in developing countries are still part of the described low external input system, and only in growing national economies or in urban/peri-urban locations do they enter the semi-intensive or even the specialised type of system.

In transition countries with restructuring economic sectors and where smallholder systems have been reinstalled, livestock systems are diverse, too, and have only limited market contact. Factors contributing to the diversity of systems are:

a) the stage of development of the national economy, influencing the demand for products, and factor costs for labour and capital,
b) the physical and institutional infrastructure and its effectiveness (transport, information access, extension and other services)
c) the recent history in Central and Eastern European Countries (CEEC) regarding the restructuring in the farming sector but also the existing traditional structure of agricultural enterprises (number and size of small farms) in some CEE countries

It is obvious that the objectives and purposes of LRS will depend on the economic stage of the livestock system as outlined in table 1.

Table 1. Interdependency of livestock systems and LRS purposes.

Purpose of LRS	Type of livestock systems: Low external input, high diversity, limited market contact	Intermediate system	Highly specialized system, high external input, market dependent
Livestock policy decision making	high	high	high
Market related information:			
• Supply forecast	low	growing	high
• Product quality assurance / public health	low	growing	high
Farm / herd management improvement	low	growing	high
Livestock performance assessment:			
• Characterisation of AnGR	high	reduced	low
• Breed / population comparison	low	growing	high
• Breed improvement	possible	possible	possible
• Product quality	low	intermediate	high

In low external input systems hardly any technical purpose exists, while issues of relevance to the sector policy, which may include relevant decisions for facilitating sector development, should be rated high. Other relevant purposes at this stage are linked to global political issues such as Animal Genetic Resources (AnGR) characterisation or estimating the value of local livestock populations as an important step in shaping a national breeding policy.

Only in fully market oriented, specialised, high external input systems the full set of purposes is pursuable in LRS.

Organisation and purpose of LRS

The organisational frame of any LRS is defined by the purpose it is supposed to fulfil and should satisfy the following principles:

a) satisfy the information needs required by its stakeholders,
b) ensure the interest of livestock owners by providing a participatory environment and feedback of relevant information or services,

c) include different institutional stakeholders and define the operational dimension, financial requirement and funding sources

Considering the diversity of purposes and system needs and the corresponding range of involved stakeholders, LRS essentially have different organisational and operational structures, partners and funding modalities.

LRS for the sole purpose of providing information to policy makers and markets or for characterising AnGR will involve livestock owners and public sector institutions such as Ministry of Agriculture, Marketing Agencies, and Agricultural Research and Extension Centres and Universities. The purpose is almost entirely directed to provide a public good and may be fulfilled by intermittent recordings. Thus, the LRS should be organised and operated by the public institutions with a "Community based participation of breeders" and the respective feedback of information.

In highly specialised intensive systems with its multitude of purposes for different interest groups / stakeholders livestock recording systems

a) need to collect information at various frequencies of various components of the production system (from production to consumption),
b) have a special purpose for performance and productivity enhancement (breeding, management),
c) provide public and private goods of relevance to the public sector,
d) and are of an increasing economic importance to the livestock producer.

The organisational challenges are directed towards the involvement of stakeholders (esp. farmers) in planning of LRS, in the establishment of cost effective LRS, in implementing effective utilisation concepts for collected information and efficient feedback mechanisms for information sharing and service provision.

The dynamic changes of purposes and organisation requirements indicate the need to establish a LRS organisation strategy for a given country, which is concerned with the following five generic problems of organisation development (Schreyögg, 1999):

1. structure of purposes (type, time of occurrence),
2. integration of stakeholders / partners (individual farmers / farmer association, public and private organisations),
3. political and legal environment for organisations,
4. decision making structure and instruments,
5. management instrument to foster changes as required by a system circumstances.

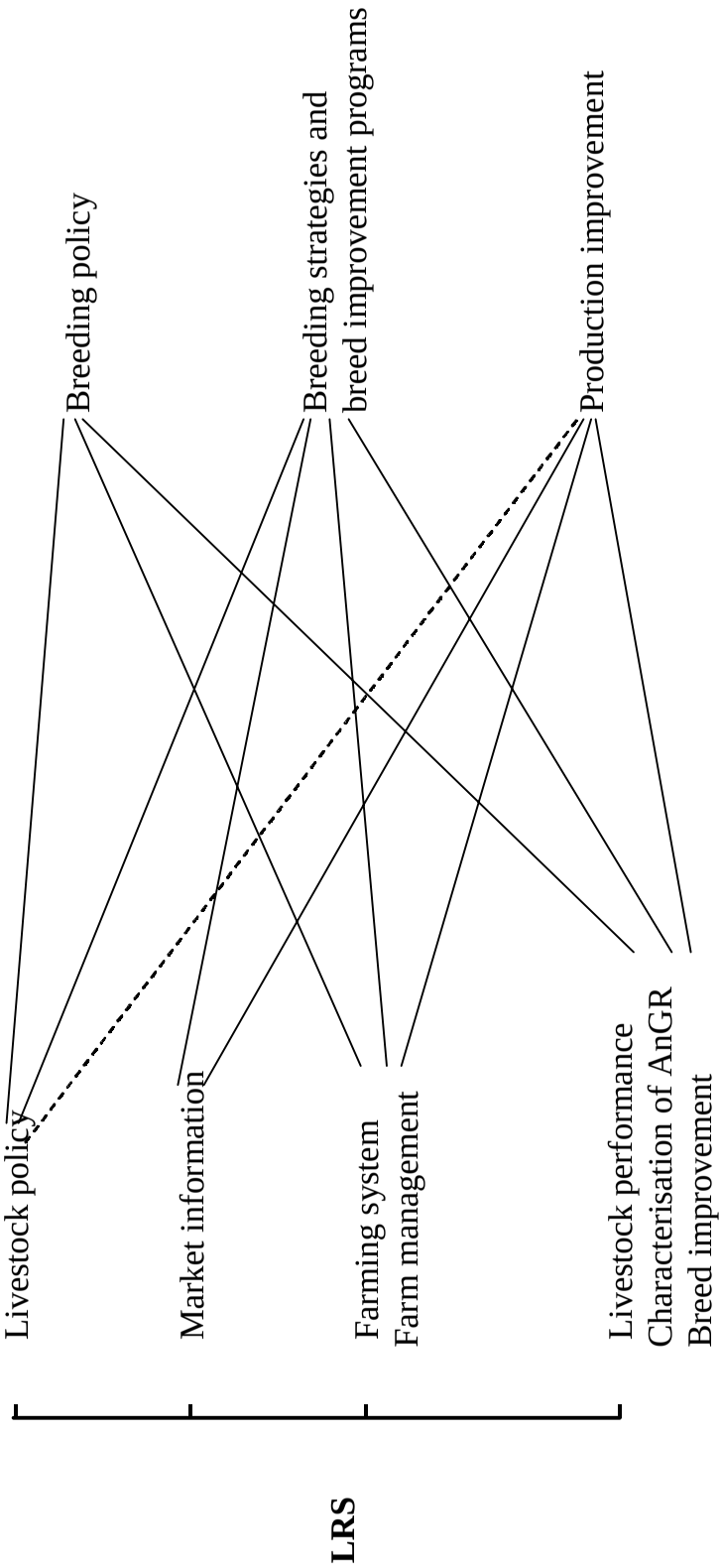

Figure 1. Information linkages for decisions and program implementation.

Information linkage

Different purposes of LRS by different stakeholders tend to lead to independent information systems covering specific aspects of the same livestock systems. Pollot (1998) summarises types of recording systems found in a livestock industry and raises the issue of missing linkages between purpose groups such as genetic resource improvement, enterprise management, farming system research, government policy, and various other schemes. Missing linkages often are a result of uncoordinated implementation of recording by different agents for different purposes but targeting the same system and livestock farmer. This situation may be understandable during the initial phase of a LRS with distinct differences between purposes (e.g. livestock and market policy versus AnGR characterisation) and interested agents. However, soon during the further development of a LRS with consolidated purposes, linkage problems are costly and affect the cost effectiveness of information collection and the appropriate analysis.

A simple example shall illustrate the need for linkage (Figure 1). The formulation of a sustainable breeding policy in a country requires information about the biological base of its AnGR, the ecological and economic environment under which these AnGR are kept and utilised (farming system), the current and perspective market linkage, and the policy framework provided for the livestock sector. Consequently, the respective institutions mandated for each purpose need to co-ordinate their tasks, the establishment of a common LRS, and to ensure the common use of information.

Another example may be very familiar to breeders concerned with breed improvement programs based on selection within breeds either at farm level or at population level. Breeding goals can only be established after knowing the economic importance of traits in a foreseeable market situation, and selection processes based on performance recording do require a careful assessment of production and management system related factors in order to attain a useful accuracy in performance comparison.

Extension services with the aim to improve the production efficiency do also require a full set of information if the service provided is to be effective.

Approaches in information collection

Many countries with either no LRS or only partial recording structures and linkage problems between sets of purposes of LRS require a strategy to evolve a functional LRS to fit changing purposes, technical means and financial abilities.

A strategy for a stepwise approach in establishing a LRS, in securing relevant partnerships and linkages, and for obtaining information in relation to needs and purposes should consider

- sampling concepts and successive steps in Livestock System Analysis (LSA) and LRS
- minimal information standards,
- and purpose oriented information requirements for performance assessment

Sampling

A situation in which it is not feasible to develop a LRS with wide coverage in a livestock sector calls for systematic approaches to obtain reliable information from a much smaller sample taken from the total.

Three major approaches prevail:

a) getting representative information on livestock system typologies, on the importance of AnGR and their average productivity, and on current management practices,
b) getting information for phenotypic characterisation of breeds, for analysing variability in management and performance among farms and among animals within farm,
c) identifying breed and trait preferences, and selection opportunities.

General methodologies for successive steps used in livestock system analysis but also in breed characterisation studies are discussed by Matheron and Planchenault (1992), Rey and Fitzhugh (1994), and Flamant (1998) and are composed of

Table 2. Sample size calculation to define a minimal data structure in animal performance recording.

$$LSD = [2 (t_0 + t_1)^2 (\delta^2_s / i + \delta^2_a / ij + \delta^2_e / ijk)]^{1/2}$$

where

LSD	=	the least significant difference (in units of SD)
t_0	=	the t value for probability 0.05
t_1	=	the t value for probability Z (1 -0.90) or 0.20
δ^2_s	=	the relative variance between sires (1 / 4 h^2)
δ^2_a	=	the relative variance between sires (3 / 4 h^2)
δ^2_e	=	the relative variance within animals
i	=	the number of sires
j	=	the number of dams or progeny per sire
k	=	the number of replicates per animal

after: Bruns, 1992.

1. Diagnostic surveys of the LS using secondary data, informal and formal once-off surveys, which cover a stratified random sample per region (macro level).
2. Establishment of a regional typology of systems, identification of types and functions of livestock populations, listing of production constraints and resources (macro level).
3. Repeated diagnostic surveys based on stratified sampling procedures to obtain representative information on farm and household characteristics, farm resource endowment, structure of the livestock enterprise, and phenotypic characterisation of breeds (meta level). The sample size is a function of the variability among farms, the variability among animals within farms, and the breeding structure within farms, esp. the number of sires being used per year. The minimum number of farms should not be less than 40 for any regional livestock system at the meta level (Baker, 1992).
4. The final step in this sampling approach is concerned with detailed animal related information for phenotypic and genetic description of breeds. The sampling should follow a stratified random sampling procedure assuring a broad genetic sample from as many farms as possible. A minimum set of 200 breeding females and 10 males per breed are required for detecting breed differences of approximately 10 % of the mean. For estimating genetic parameters, at least 20 sires, each mated to at least 20 females are required (Baker, 1992; Bruns, 1992). The sample size calculation demands information as outlined in table 2 (micro level).

This stepwise approach with its macro, meta and micro survey levels will provide valuable information for all purposes of a LRS and establishes sufficient opportunities for developing a "standard" all encompassing LRS.

Minimal information standard

Information acquisition is a costly exercise, especially in cases where repeated measurements are required to obtain a complete and accurate assessment base. Utmost care is therefore required to only record and collect data essential for the given purpose. A clear distinction needs to be made between a "scientific" and a purpose oriented LRS approach to information collection and analysis.

Standard sets of essential information linked to specific purposes and required answers need to be established with carefully considering the need, practicability in obtaining information, costs involved, accuracy, and alternative means of getting the essential information (auxiliary traits). Some data sets of LRS are compiled in table 3 mainly covering the farming

system, the production system and livestock performance assessment. For each data set the question has to be solved regarding the necessity of information, measurement methods, repeatability, accuracy, necessary frequency of data recording and predictability for estimating the aspired information.

Particular problems are associated with data sets which require time series information (milk, eggs) but also with those information based on continuous input and output events. The minimal information requirement for a farm model to calculate gross margins or profit functions, as shown in table 4, provides a simple dimension of the problem for obtaining such data in farming systems in less organised economic environments. The tasks at hand are related to the application of sampling methods, re-call, once-off and structured repeated surveys / recordings, supported by the use of general market data (prices for output and input components).

The appropriate assessment of feeding systems and budgets can also be of concern since precise direct recording systems are very time consuming and costly. The assessment of feed resources available on the farm demands cost efficient, alternative methods such as applied by Abdinasir (2000) for a smallholder dairy system. Farmers' information on land use and types of crops grown, together with empirical information on grain-straw yield rations for each crop grown are used together with the farmers' re-call information on grain yield to predict straw yield. A similar procedure is used for predicting forage availability and yield.

Livestock performance information

Setting breeding goals

In all livestock systems animals are kept for defined but varying purposes. These purposes may involve a large number of traits (multi-purpose) or only special traits (single purpose). The utilisation of performance traits then often depends on the expression of a number of biological functions or traits, which even in a single purpose situation demands the consideration of several traits. Thus, one of the first decisions to be made is the definition of a breeding goal / objective and the traits involved in expressing the genetic merit. The definition of a breeding goal is a decision to be made by the owner of the breeding population, and as James (1998) argues, often tends to be arbitrary and only in recent times breeding goals have been defined in a structured way based on considerable information about trait variability and production functions.

In many situations with an imperfect information base the widely accepted approach to define breeding goals from production functions is not feasible. Attempts are therefore required to assist breeders in making decisions on breeding goals through a set of stepwise methods responding to the sources of available information:

a) initial information on existing arbitrary or customary breeding objectives can be obtained through the application of a "community based participation matrix ranking" of preferred functions, traits, selection criteria and breeding decisions as proposed for and applied in less developed livestock systems by Steglich and Peters (2001)
b) information from farming system surveys (samples) about production costs, performance indicators, performance variability, estimates, combined with population parameters (obtained from literature) and breeders' perceptions of the importance of traits allow a first economical assessment of breeding goals as suggested by Kosgey *et al*. (2001) for small ruminant systems in communal grazing conditions,
c) information from a meta and micro study using a genetically connected stratified sample as described by Bruns (1992) will allow population parameter estimation for the population in question. Together with

Table 3. Data sets in LRS and the need for minimum information standards

1. Production environment

Location, climate
Farming systems, production systems
Feed resources and feeding system / budget
Management system

2. Identification data

Individual animal identification system
Animal bio data (birth data, breed, sex, litter type, etc.)
Pedigree data

3. Performance related information
3.1. Functional traits
Fertility: oestrus and conception occurrence post partum, conception efficiency
Health: udder, legs, feet occurrence of other diseases and disease resistance
Reproductive wastage: prenatal and perinatal losses
Milkability: milking ease, animal behaviour milk, let down
Physical traits: linear body measurements
3.2. Production traits
Milk: yield, contents, quality
Growth: weight gain, lean, meat quality, feed conversion
Egg: clutch size, clutch number, egg mass, egg quality
Fecundity: litter size, rearing rate
3.3. Productivity and production efficiency
Biological production efficiency
Economic production efficiency

Table 4. Minimal Farm Model for Gross Margin/Profit Function Calculation.

- Gross margin calculation (Dairy)
  - Gross output (volume, price)
    - Milk, calves, cull cows, manure
  - Variable costs (volume, price)
    - Replacement
    - Type: farm grown, purchased
    - Feed (nutrient requirements)
    - Operational cost
  - Resource requirements
    - Labour (hours, type)
    - Capital requirement for current assets
    - Capital requirement for fixed assets
- Required information
  - Type of animal (breed, live weight)
  - Housing system (type, cost, durability / depreciation)
  - Herd size (replacer)
  - Labour input
  - Production parameters (e.g. milk yield, calving interval)
  - Input parameter (e.g. nutrient demands, type of feed)
  - Prices of marketable outputs and inputs
- Purpose
  - to assess the economic performance and competitiveness of the production enterprise
  - to quantify resource requirements
  - to provide a basis for farm planning
  - to calculate efficiency measures for the farm
  - to assist definition of economically based breeding objecting

economic production information from the farming system analysis (stratified sample) it is then possible to apply a first structured definition of a breeding goal.

However, the establishment of a cost-benefit analysis for various traits requires extensive investigation to obtain reliable information on population parameters, cost structure and product values. Together with a good understanding of present and future market impacts on product prices and production costs it is only then possible to define a breeding goal with some degree of accuracy.

However, even at this stage one has to be careful not to rely only on production function equations but to carefully relate estimates to the reality of production systems and breeders' perceptions. This might be especially important in multi-purpose livestock systems in situations with considerable uncertainties about natural and economic production conditions, and with rather high natural disease challenges.

Groen *et al*. (1997) rightfully point out in the report of an EAAP working group dealing with economic values in dairy cattle breeding, that one of the basic draw backs of objective methods to define breeding goals based on modelling with economic values is the use of historical prices and production data, while breeding is future oriented. This has to be kept in mind when positive approaches (data evaluation) or normative approaches (data simulation) are applied for profit function or bio-economical models to derive breeding objectives.

Non-objective methods do not derive economic values by direct calculation of influences of improvement on the increase in efficiency of the production system. They may be more appropriate for livestock systems in which production conditions are constrained by factor limitations (health, feed, management complexity). As outlined by Groen *et al*. (1997) these methods assign economic values in order to achieve a distinct genetic gain and are useful to examine the limits for genetic improvement.

Identification

A clear and sustainable identification system of animals of a population subjected to performance recording and selection is proclaimed as one of the essentials of a breeding scheme. While it is acceptable that repeated recording of individual performances does require an individual and durable identification, purposes such as performance characterisation or productivity assessments in stratified samples may need to be pursued without a comprehensive system of identification.

In any given situation it is essential to assess identification needs and possibilities for a number of reasons:

a) Livestock owners may resist the identification and registration of their animals in situations where taxes are imposed on livestock, or where customary believes counteract any infliction on an animal (ear tag, branding, tattoos, ear carves).
b) Traditional ways to identify animals within the herd may exist, which are sufficient for once-off performance assessments based on owners' descriptions and even repeated recording as part of a farming system survey to characterise populations.
c) Temporary identification systems using paint markings or strings (leg, neck, horn) may overcome traditional identification constraints and fulfil all demands for individual repeated recordings. This method may be used in schemes where best animals are identified based on owners' records and which are subsequently subjected to a comparative performance recording for ranking purposes and the start of a breeding nucleus.

However, a master plan for a comprehensive identification system which involves such factors as geographic location, country, region, county, village, breed code for pure breeds or crossbreds, breeder code, and individual animal registration number could and should be established as soon as repeated recording and systematic selection programs are commencing. Even if these action do not encompass the whole population, but are employed on a stratified sample as part of an initial farming system survey, as part of a stratified population sample for specific characterisation and population parameter estimation, or as part of a sample recording scheme involving pre-selected animals, the partial application of a identification master plan will be more efficient than separate and uncoordinated ways of identifying animals (Crettenand, 1999).
In many CEE countries such a scheme is already established. It may not always involve all smallholder livestock owners but can be extended to fit the future needs (Vares *et al.*, 2001).

In Europe standards for identification and registration of animals are set by the EU, and CEE candidate countries need to fully apply the binding rules (Hodges, 1999).

Performance assessment

The application of intensive recording schemes as evolved and used in intensive and high performance systems of industrial countries may not be the appropriate solution in less developed situations. The record of failures of such over-ambitious LRS is unfortunately large and has raised the claim to search for alternative appropriate approaches (Trivedi, 1998; Vares *et al.*, 1999).

Direct recording of performance traits or their associated auxiliary traits has been well established for intensive LRS for dairy, beef, and others (Simianer *et al.*, 2001; Vares *et al.*, 2001; Vares *et al.*, 1999). Given the high level of system development, large uniformity of production and

management systems, most of these LRS fulfil the requirements of practicability and accuracy, with regard to precision of measuring instruments, measurement methods, and recording method, and are sufficiently able to identify and measure systematic influencing factors for correction of performance data (James, 1998). The remaining problem is however, to reduce the cost of recording in times of dwindling public support for recording. In many LRS attempts are under way to test the impact of reduced recording frequencies on the accuracy of production, or to incorporate technological innovations to improve performance recording by livestock owners (B control methods). Organisational complexity and high costs are of special concern in attempts to record repeated quality traits, such as milk fat and protein or somatic cell count, which require sampling techniques, shipment to laboratories and rather costly analytical procedures.

Problems in LRS are much more aggravated in livestock systems with a lower productivity and, thus, a higher cost-sensitivity in recording. The livestock production process in these systems tends to be restrained by a number of factors such as:

- larger fluctuations in natural conditions with impact on fodder quality and quantity,
- lower external input of feed stuffs and thus instable feeding system,
- larger differences in management techniques and skills,
- high phenotypic performance variability complicating the assessment of time bound yields.

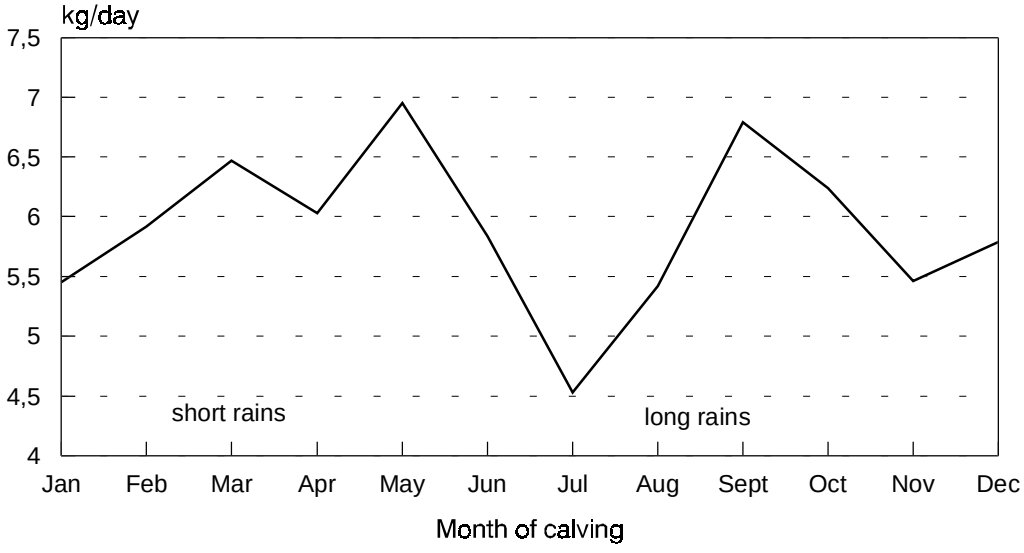

Figure 2. Lactation pattern of Friesian-crossbred cows in the Ethiopian Highlands, after Varvikko, 1991.

These situations do require a high frequency of recording to attain the esteemed accuracy which often is not feasible due to the associated costs. A typical lactation curve of crossbred dairy cows obtained under "improved" small holder dairy conditions in the Ethiopian highland proves the recording problem.

What alternative approaches could be considered in recording?

a) The first step would involve the establishment of an animal history with owner involvement to quantify performance, and to possibly

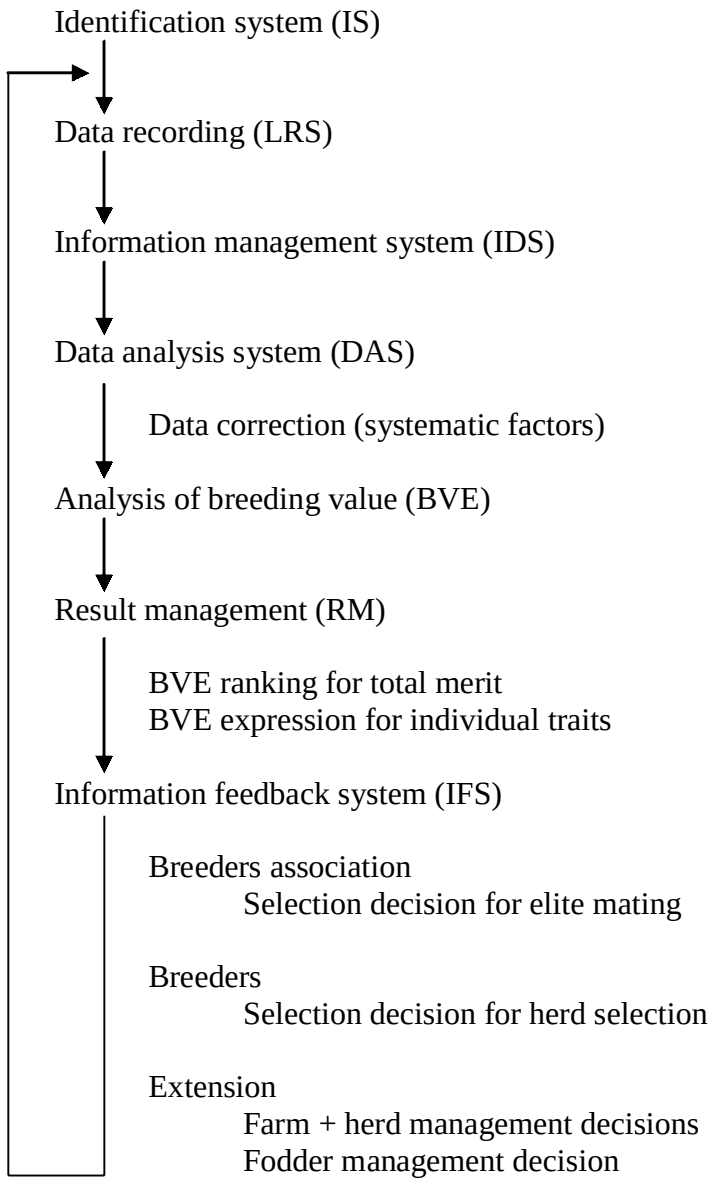

Figure 3. Organisation of information and results in LRS.

apply a matrix ranking for traits among animals. Animal performance histories are established for the following traits
- fertility (calving / lambing intervals and frequency, litter size at weaning),
- milk yield estimates (yield during 1st, 2nd and 3rd part of the lactation period), lactation length,
- weaning rate and weight score,
- functional traits,
- incidence of illness and diseases,

b) A second step involves the application of individual performance recording of sample animals (stratified positive performer sample) following a set of methods which may include:
- official repeated recording by enumerators
- alternative recording by enumerators and livestock owners
- owner recording of traits according to an agreed measurement technique and frequency pattern (daily for milk) with infrequent "visits" by enumerators to provide additional services and to "test" records

After the establishment of full sets of records further regression calculations of different measurement frequencies estimating the true performance should be made to simplify the recording process.

Data organisation and management demands

Livestock recording is known to be a rather complex undertaking which demands a stringent organisation and management scheme to be successful.

The different tasks and steps involved from the identification system to the information feed back system, as illustrated in figure 3, are highly interlinked and interdependent. Success of a LRS depends on the functionality of every step / task and, thus, a concerted organisational effort with stringent task co-ordination and process control is essential for reaching the objectives of performance recording in livestock systems. Responsibility for task implementation, methods to be used, information flow processes, result management and feedback systems have to be determined, administrated, managed, put to financial analysis, and constantly improved. Another typical area where research for development provides a prosperous collaborative working base for scientists, extension specialists, policy makers and breeders.

Conclusion

Livestock recording systems are complex actions with the final aim to improve the efficiency of the livestock sector. Purposes, approaches and the composition of tasks vary according to the system circumstances. A systematic analytical planning approach seems advisable to combine stakeholders, to specify objectives, opportunities, problems and perspectives. Major challenges in organising efficient LRS in developing

countries are associated with the low degree of attainable information and the high cost sensitivity, and in European transition countries with the coexistence of large scale and small scale livestock systems.

LRS should be established with a clear understanding of sustainable standards following a stepwise process guided by a conceptional master plan. This process needs to be concerned with purposes, tasks, interdependencies, linkages between stakeholders, methods, processes, information flows and the respective responsibilities and accountabilities of all institutions and individuals involved.

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Dairy cattle recording in large-scale and smallholder commercial herds in Zimbabwe

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Background

The dairy industry in Zimbabwe comprises three sectors; the large-scale commercial farmers who produce milk mainly for the urban population, the smallholder subsistence who produce milk for their own consumption and the smallholder commercial producers who supply mainly the rural population with excess sold to urban processing plants. The latter group was introduced after Zimbabwe's political independence in 1980 and has been growing in numbers since then. For more details on Zimbabwe's dairy production systems, see a review by Smith *et al* (1998). Milk recording services exist for the large-scale and smallholder commercial sectors.

Milk recording in the large-scale commercial sector

For the large-scale sector, milk recording was introduced in 1929 with official milk recording starting in 1932. There has been changes in management of the scheme, type of data collected, and use of data collected over the 70 years (1932 to 2002). The developments in the scheme were described by Banga (1998).

The scheme has always been run by a government department in the Ministry of Agriculture. Farmers were charged a nominal fee and virtually all costs of delivering the milk recording services was bone by government. In 1993, a dairy herd improvement association was formed, and that association and the government jointly administered the new milk recording services. The cost of running the scheme is being shifted gradually to farmers.

Initially the scheme collected basic production records and these were processed manually. Later a more detailed scheme was introduced where farmers were required to collect information daily. Milk records office staff visited farmers bi-monthly to check the information collected by farmers, record milk produced and compare with figures collected by farmers, collect samples of milk for milk compositional tests to be carried out at the

milk records office. Records were processed and information made available to farmers at the end of the year. Initially the information sent out was just herd averages. Starting in 1986, breeding values were estimated and participating farmers received at the end of the year a *sire summary* with breeding values for bulls used in the recording herds. They also received estimated breeding values for top cows in their own herds. A new milk recording scheme, adapted from Canada, was introduced in 1993. This new scheme provided an opportunity to collect more information at more frequent intervals. With automation and computerisation, the scheme is able to generate and send out regular reports to farmers. This scheme also introduced the estimation of breeding values using the animal model.

Milk recording in the smallholder commercial sector

Commercial dairy production in the smallholder sector was introduced under the Dairy Development Programme (DDP) which was initiated by the Dairy Marketing Board (a parastatal organisation) in 1983. The Dairy Development Programme was later moved to a different parastatal, the Agricultural Rural Development Authority (ARDA). The DDP was funded by Norwegian, Danish and British governments. The aim of DDP was to introduce commercial dairy production in communal, resettlement and small-scale commercial farming areas (Mupunga and Dube, 1993). These herds were to supply milk to the rural people who were situated far from the formal distribution centres and deliver excess to city processing plants.

For the purposes of extension, supply of inputs and marketing of milk and milk products, farmers were encouraged to work as a group and each group was centred around a milk collection centre. Members of the group included producing and non-producing herds (also referred to as active milk producers). The non-active members are prospective milk producers. Some of the main concerns during the early stages were; supply of dairy animals (appropriate genotypes), teaching farmers basic principles of dairy production including the keeping of records and marketing of milk. These were addressed first and milk recording in this sector started in 1993 when the new milk recording scheme for the large-scale sector was introduced. Milk recording services were given to smallholder farmers as a group.

Management of the milk recording scheme

The Zimbabwe Dairy Herd Improvement Association (now called the Zimbabwe Dairy Services Association or ZDSA) was formed in 1993. Part of its mandate is to run the milk recording scheme for the dairy industry.

The chief dairy officer is the person in charge of ZDSA. Her immediate subordinates are officers in charge of the dairy laboratory (for testing the hygienic and compositional quality of milk from dairy herds and compositional tests for individual cows) and the one in charge of milk recording services. The milk recording services employ milk recorders

who visit members of the scheme to collect milk samples and data on farms. There are also staff based at the central office who analyse milk samples and process data received from farms to produce reports which are sent back to farmers and other interested organisations. Further processing of data is now done by an organisation called the Livestock Identification Trust (LIT). The LIT is a joint venture between farmers and the government. For the smallholder sector, the DDP helps in collection of records.

Sources of funding for the milk recording scheme include dairy industry levies, government support and fees paid by farmers. Unlike with earlier schemes, the farmer fees are the biggest source of income for the milk recording services and the aim is to gradually phase out contributions from levies and government.

Current recording programmes for the large-scale sector

The are two types of recording programmes for the large-scale sector, the fully supervised official recording and owner recording. For the fully-supervised programme, ZDSA staff (milk recorders) collect and record the data. The records completed on this programme are certified and published. For the owner recording programme, a herd owner collects and records the data after instruction and with regular assistance from a milk recorder. The records from this programme are not certified and may not be published as proof of individual performance although they may be printed for owner use.

The number of herds participating in milk recording from 1983 to 1994 has ranged from 18 to 24 percent of the total number of large-scale commercial dairy herds (Banga, 1998). The membership of the milk recording scheme is not improving mainly due to lack of appreciation of usefulness of dairy recording by farmers. Lately, the size of the national dairy herds has also been decreasing and among herds leaving the dairy industry are milk-recorded herds.

The records collected can be broken into four types:

1) *Identification*: The main and first step in recording is the identification of animals in the herd. The animals are classified by breed and differentiation made between purebred and grade animals. Animals get a unique number for use by the recording scheme. The name and / or number given the animal by the farmer is also recorded.
2) *Reproduction*: Data collected includes date of calving, days dry, calving interval, parity, and lactation length.
3) *Production*: Milk yield is recorded at milking and laboratory tests carried out to determine butterfat and protein content for milk samples collected.
4) *Health*: Milk samples are also tested for mastitis by carrying out somatic cell counts.

A minimum of ten test days is to be provided to each herd each year and the number of days between two consecutive test days should normally not exceed 50 days and if they exceed 75 days, that record cannot be certified.

Current recording programme for the smallholder sector

Because of small herd size, smallholder dairy herds normally participate in a Group Testing programme. Under this programme, several herd owners belonging to a formal collective milk marketing scheme participate in an owner recording programme in which all cows in the scheme are tested as one herd.

A group is admitted into the milk recording scheme if a minimum of one third of active milk producers join the scheme. A Group Co-ordinator is chosen who is responsible to the testing authority. For each Group, trained supervisors conduct regular test days, carrying out tasks similar to those done by milk recorders for large-scale commercial recording programmes.

Other technical requirements and information collected under this programme is similar to that collected for the programmes described for the large-scale commercial producers.

Processing and use of milk records

The records are processed to produce test-day and annual reports for member herds.

Test day reports

The test-day reports are essentially in two parts; individual cow information and herd information. For individual cows the following information is provided; identity, calving date for current lactation, age at calving, parity, milk yield on test day, days in milk, milk component test results, and accumulated totals for current lactation for days in milk, KGs of milk produced and KGs of components produced. For the herd, a rolling breed herd average for milk production is given. After an animal has completed all test days under the Official test, a certificate of production is issued. The information listed on the certificate includes:

- the exact identity of the animal
- all lactations that have been completed on Official test for the animal
- lifetime averages of records completed on Official test for the animal
- information on individual records which includes age at calving, date of calving, production totals for 305 days and for total lactation (both milk and component production totals), component percentages.

Annual reports

The annual reports are called Herd Averages. These reports are an historic record of what happened in the herd. These averages are calculated annually from the production records of dairy cows that have completed a lactation between 1 January and 31 December in the year under review, or been in milk for 305 days as at 31 December. Details of records qualifying

for use in calculating Herd Averages are given by ZDSA (2001). Only participating herds that have been actively recording throughout the year under review and had at least six farm tests have a Herd Average calculated. Cows that were dried off or left the herd before having been in milk for 250 days are excluded from the calculations. Herd averages have been the main report that the farmers have been receiving but their content has been changing over the years. The most recent publication of herd averages at the time of writing this paper was for the year 2000 and it is divided into seven sections:

- *Section 1*: Herds are ranked by breed and 305-day milk production. For each herd, an average for milk yield, fat yield, protein yield, calving interval, lactation index and number of records used to calculate the averages is given.
- *Section 2*: Herds are ranked by breed and combined fat and protein yield for 305-day lactations giving information on milk yield, fat yield, protein yield, combined fat and protein yield, and number of records for each herd.
- *Section 3*: Herds are ranked by breed and net return for 305-day lactations. Net return, milk yield, fat yield, protein yield, lactation index, calving interval, days dry and number of records are given for each herd.
- *Section 4*: Herds are ranked by milk production per herd-size class. The herd-size classes are 1-50 cows per herd, 51-100, 101- 200 and >200. For each herd, information given is net return, milk yield, fat yield, protein yield, calving interval, days dry and combined fat and protein yield.
- *Section 5*: This section has two subdivisions. Section 5 (i) gives breed averages by year (for example 1996 to 2000) for milk yield, fat yield, protein yield, calving interval, days dry, combined fat and protein yield and number of records. Section 5 (ii) is a table of calving pattern and number of animals culled for the year under review. The number of cows that calved or those culled are given by month.
- *Section 6*: This section gives information on somatic cell counts. Section 6 (i) gives average somatic cell counts by herd over several years (e.g. 1996 to 2000) and number of records used to calculate the average. Section 6 (ii) gives somatic cell count bands for milk recorded herds over several years. The bands used are <300, 301-400, 401-600, 601-750, 751-1 000, >1 000 000. For each year, the number of herds in the milk recording scheme falling into that band are given and what percent of the total number of herds they constitute.
- *Section 7* lists the top cows by breed, the ranking being on milk yield. The top 20 cows are listed for the Holstein breed and top 10 for other breeds. For each cow, the herd in which it was milked, its unique identity number, its name, age at calving, milk yield, fat yield and protein yield are given.

Table 1. Breed averages for the year 2000 for the large-scale commercial sector.

Breed	Milk yield (kg)	Fat yield (kg)	Protein yield (kg)	No. of records in average
Ayrshire	4 839	194	164	92
Guernsey	6 043	252	201	67
Holstein	6 376	234	210	4 885
Jersey	4 997	221	179	498
Red Dane	5 616	247	198	560
Overall	5 574	230	190	6 102

Source: Zimbabwe Dairy Herd Services, Annual Herd Averages for the Year 2000.

The use of records

Table 1 gives breed averages for the year 2000 for the large-scale commercial sector.

Milk recording produces information whose primary use is for management for the participating herds. Test day information is used mainly by producers for management. This information, as described above, is normally processed further and outputs (e.g. herd averages) used by various organisations including farmer organisations, universities, and government departments, e.g. the Central Statistical Office and Research and Extension in the Ministry of Agriculture. The information has also been used to calculate breeding values used in selection although the use of records for this purpose has met a lot of problems.

Even if the information produced by milk recording services has value on a national basis, national benefits of milk recording in Zimbabwe are largely untapped. The use of records has been limited to the occasional research project undertaken by post graduate students (e.g. Mpofu 1987; Mpofu *et al*, 1992) and to production of herd averages (ZDSA, 2001). Regular use of milk records would be in national planning for the dairy industry. For example, data from the smallholder sector can be used in planning further development projects / directions for this "new" sector (for examples see Mpofu, 1995 or Venge, 1997) or in drawing long-term development plans for the dairy industry (e.g. Mpofu *et al*, 1992; Mpofu *et al*, 1993). Data from both sectors can be used in resolving demand / supply and cost / price issues that so bedevil our industry.

Conclusions and recommendations

The main problems with the Zimbabwe's milk recording scheme after the introduction of the new scheme in 1993 can be classified into two main groups; that of membership and that of effective use of records. Membership has failed to rise (Banga, 1998) and now it is going down as farmers leave the dairy industry due to unfavourable production conditions. Although the Scheme is now funded mainly by members, the government's contribution should continue or even be increased especially

to cover extension and recruitment of new members to the Scheme. There is a real need to study the problems of milk recording in Zimbabwe for both sectors. CARNET (1995) gave four constraints to milk recording in the smallholder sectors in East and Southern Africa and some of these could be the reason for low membership. However, a detailed country study is needed and it should provide suggestions for the way forward. It can also be used as a case study for other countries in the region.

Setting up and running a milk recording scheme is quite involved and uses a lot of resources, thus making it imperative that records collected are fully utilised. Member herds are the main users of the records and with the improved scheme, they have been able to use records more effectively than before as the turn-around time for test day records was reduced. Before the new scheme, farmers used to receive only herd averages at the end of the year. However, as alluded to in sections above, the records are not fully utilised. The study referred to in the preceding paragraph should also include a survey of potential users for the data and find out what their main constraints to using the data are. Suggestions on data flow, its use and feedback and innovative ways of using the milk records (to produce informative / usable reports) can be made.

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Summary and conclusions

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Introduction

The Interbull meeting and 33rd session of ICAR were held in Interlaken, Switzerland from May 26 to 31, 2002. In this connection a joint ICAR / FAO seminar was conducted to discuss how sustainable livestock development can be enhanced in developing and transition countries through efficient organization of animal recording and skills development. The seminar referred to ICAR's earlier efforts to develop approaches and solutions in smallholder production environments for animal performance recording in the South and East:

- Animal recording for smallholders in developing countries, Anand, India, 1997.
- Cattle identification and milk recording in central and eastern European countries, Warsaw, Poland, 1998.
- Developing breeding strategies for low input animal production environments, Bella, Italy, 1999.
- Animal recording for improved breeding and management strategies for buffaloes, Bled, Slovenia, 2000.

Structure of the seminar, speakers and discussions

After the opening of the seminar by ICAR president J. Crettenand, the global context, the frame conditions and the recent trends were introduced by three papers (J. Maki-Hokkonen, FAO; T. Vares, FAO; T.W. Schillhorn van Veen, World Bank). Two review papers discussed the development trends in livestock identification and recording (K.J. Peters; J. Phelan) and seven case studies illustrated and discussed approaches and experiences in relation to efforts to improve animal recording systems in transition and developing countries, focusing mainly on smallholder systems in cattle, goats and sheep. The case studies were presented by R. Cardellino, FAO / Uruguay; C.T. Chacko, India; M. Klopcic, Slovenia; A. Kretov, Kyrgyzstan; B. Moioli, Italy; N. Mpofu, Zimbabwe and R. Sadek, Egypt. The presentations were followed by a structured plenary discussion. A summary, major conclusions and recommendations were presented in the plenary session along with the presentations of the ICAR sub committees, task forces and working groups.

Global context, frame conditions and underlying recent trends

The rapid increasing demand for animal products in developing and transition countries has been widely discussed in the recent years. Delgado's predictions are starting to become reality as a recent update of the data of the 1999 publication (Delgado et al. 2001) reveals. There is an increasing concern for livestock and environment issues. The introductory papers referred to the Livestock Environment and Development initiative (LEAD) which is specifically addressing livestock environment interactions in developing and transition countries. Furthermore, there is increasing concern for food safety which calls for better methods to trace livestock and livestock products. There also is growing concern in view of the trend that rural smallholders are being increasingly marginalized in spite of a rising demand for livestock products in developing and transition countries. This trend expresses itself as lack of access to inputs and markets for smallholders, due to an array of reasons such as remoteness of the smallholder dwellings, missing quality standards and erratic supply potentials.

Trends in transition countries

The inherited ownership structures in the transition countries are changing at a slower pace than expected. Real and tangible reforms take a lot of time. The major impact of the transition for the mainly small livestock keepers are the decreasing livestock populations and an almost total loss of the erstwhile markets. These developments lead to increasing poverty among the livestock keepers and to a migration to urban areas in some countries. The role of the livestock sector in the transition countries has shifted from being a major source for food and raw material (e.g. wool) to a role which, in addition to food and raw material, also includes risk aversion and social buffer elements. The aim clearly is, as stated in various case studies, to work towards the establishment of livestock as a significant source of income, without jeopardizing the presently very important social buffer element. While the introductory paper painted a rather gloomy picture of the livestock sector and specifically the animal identification and recording elements of livestock production, the case studies demonstrated that there are examples which prove that progress, though slow, is being made in various countries and programmes.

Identified key elements

Driving force for identification and recording needs. The driving force to start an animal identification and recording system often is a selection programme to develop and preserve local genetic resources for milk production. Organised dairy farming projects often start by identifying a suitable market, capable of absorbing increasing quantities of milk while in the case of life animals and meat the driving force for identification and recording systems often are requirements of export markets which demand traceable products. However, even in these contexts animal identification and recording do not always enjoy a high priority.

Benefits of identification and recording are not obvious to the smallholder livestock keepers. The seminar discussed the economic benefits of animal performance recording systems and concluded that there are more benefits of recording than just making genetic improvement possible. Examples of such benefits are management information and a higher value of the recorded animals in the market due to available performance records. This fact is not well understood by various stakeholders and needs to be communicated to all concerned more specifically. The quantification and documentation of such benefits must become a priority research issue. Economic models on costs and return on investment in animal recording programmes need to be developed and published.

Private public partnership. In the East and South the importance of efficient Private Public Partnerships (PPP) for livestock development and herewith for animal identification and performance recording has been stressed in various case studies and also in the discussion. There is a need to improve networking and make knowledge and experience available both to public as well as private institutions. There are indications, that private institutions are willing to pay for such services, provided the economic long term benefit can be demonstrated.

Legal and policy framework. Legal and policy frameworks and strategies often are not conducive for the new production systems in the transition countries. The debate in the seminar, whether to set priorities on developing "made to measure" policy frameworks or on the demonstration of functioning identification and recording systems, concluded, that both elements are important and that the best approach is to involve the policy and strategy makers into the development of the systems at an early stage.

Management and administrative effectiveness. Animal identification and performance recording systems, to be successful and to yield the expected results, need to be run efficiently and professionally. The seminar discussed the administrative effectiveness of government versus private structures. On the one hand, government structures often are not very responsive to the need of these systems, on the other hand, government needs to be involved both for the development of policies and strategies as well as for finance. The question was also raised how to improve systems which are well established but somewhat have become routine and are not developing any further without additional efforts and inputs.

Conclusions and Recommendations

Research needs. Clear and focused research and development priorities for identification and recording systems in CIS and CEE countries need to be established. Research priorities to establish a toolbox for identification and recording tools need to be established. An important tool will be the establishment of a system to efficiently and accurately estimate the costs of such programmes. Research is also needed to further develop adapted

animal identification systems, tuning cultural and traditional aspects with sophisticated technical solutions. To develop a set of ICAR standards which define optimal service packages including reporting and feed back mechanisms to the livestock keepers and defining adapted recording intervals, is another important area of research to be done.

Demonstration and communication of economic benefits. The demonstration of economic benefits of animal recording (recommendation of ICAR seminar, Anand 1997) needs yet to be done. On the one hand this should be a research priority, on the other hand it will be a big step ahead if successful cases are properly documented and are made available to a wide public via publications both printed and on electronic platforms. An important element in these documents will be recommendations on strategies on how to upscale and replicate successful pilot programmes.

Sustainable use of domestic animal genetic resources. In the context to support the development of sustainable livelihood systems in rural and often mountainous areas, the sustainable use of local domestic animal resources has become an important development issue. In order to do selective breeding within these indigenous breeds, these programmes need to apply identification and performance recording tools. This is another important reason why ICAR needs to continue its efforts to develop comprehensive animal identification and performance recording tools for smallholder livestock systems.

Global network versus regional initiatives. The global network (ICAR seminar proceedings, seminars, etc.) is appreciated. However there is an expressed need for regional initiatives in order to intensify the sharing of experience, to develop region specific solutions and to allow a larger group of persons to participate. The plenary discussion recommended to ICAR to explore the possibilities to establish such regional networks, possibly species specific, without abandoning the global platforms such as the Interlaken seminar. Such regional networks would need the support of NARS and regional research networks. The question on who will finance these regional initiatives remained unanswered.

Overall recommendation. The seminar recommended to develop model procedures on how to start animal identification and performance recording programmes. These model procedures with checklists for the major requirements and tested approaches could serve as a baseline. Case studies, as the ones presented in Interlaken, would then be used to refine and complete these model procedures. This approach over time, would result in a set of best practices, based on tested and successful field experience. The seminar concluded with the overall recommendation that the setting of proper research priorities and the question on how to learn more efficiently from each other‘s experience need to remain in the centre of ICAR’s attention.

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