Section B

Structured breeding programmes

1 Introduction

This section presents a review and analysis of breeding programmes based on the information provided in the Country Reports. Country priorities with respect to species and breeding objectives are first set out, followed by details of the organizational structures and tools used. Regional descriptions of the state of breeding programmes for the various species are then presented. The review ends with some general conclusions about the state of breeding programmes in the countries considered.

Breeding programmes are here defined as systematic and structured programmes to change the genetic composition of a population based on objective performance criteria. Pure-breeding is defined as breeding activities within a specified breed, and cross-breeding as the systematic or unsystematic combination of two or more breeds. Breeding activities conducted by individuals or small informal groups of breeders are not considered.

The analysis is based on the 148 Country Reports that were submitted by July 2005. For some countries, additional sources would have been available, but a common basis for the analysis was considered preferable, and only the information provided in the Country Reports was, therefore, utilized. Although most Country Reports have a common structure, the way in which breeding activities and breeding programmes are reported is very variable. The information is presented in different chapters, and is discussed in relation to different topics. Countries with active conservation programmes gave more emphasis to the reporting of breeding activities involving breeds under conservation programmes than to the main breeding programmes. The quality of the information and the degree of detail presented are, thus, very variable. Information about objectives and the scale of the active breeding population is not provided in many Country Reports, and in several cases it is difficult to conclude whether the reported breeding programmes are actually being implemented, are planned, or are historical events. Collecting more detailed information through further requests to the countries concerned was not considered feasible in the time available.

About 70 countries submitted information about breeding activities utilizing pre-defined tables. In the following discussion these countries are referred to as the "subsample countries" (see Annex Table 67). These countries provided data on the total number of breeds, and the number of breeds for which there are specified breeding goals and breeding strategies, and for which individual identification, performance recording, genetic evaluation procedures and AI are implemented. The data are analysed and reported on a regional basis. However, when interpreting the results, it is important to consider that the extent to which breeds are actually exposed to the reported tools/technologies may vary greatly across a region.

For the major species – cattle, buffaloes, sheep, goats, pigs and chickens – countries are classified according to whether they regard breeding programmes as a priority, and whether they actually have breeding programmes. The existence of breeding programmes was also recorded for

horses, camels, rabbits, turkeys, ducks and geese. Countries are considered to regard breeding programmes for a given species as a priority if they are specifically mentioned as such in the Country Report, or if activities of breeding associations for the species are reported. The number of countries which consider breeding programmes as a priority is, thus, larger than those which have existing programmes. If the priority and existence of breeding programmes could not be clearly established from the Country Report it was classified as "not mentioned". Information about breeding programmes is presented on the basis of the regions Africa, Asia, the Near and Middle East, Europe and the Caucasus, the Caribbean and Central America, South America, North America, and the Southwest Pacific.

For the classification of animals into breeds, this review follows the usage in the Country Reports. Where information is presented regarding the numbers of breeds in the different regions, transboundary breeds are counted more than once – regional totals are therefore the sum of the number of breeds in each country

2 Species priorities and breeding objectives

Breeding objectives are influenced by a wide range of factors, and have to consider the needs and priorities of the animal owners or producers, the consumers of animal products, the food industry, and increasingly also the general public. The relative importance of the different factors varies depending on the species, and the priorities and development-stage of the country. It also changes over time. The more important functions and requirements of breeding programmes are to:

- increase production and product quality;
- increase productivity and cost efficiency;
- maintain genetic diversity;
- support the conservation and use of specific breeds; and
- consider animal welfare and sustainable systems.

Finding the right balance between the different demands is a continuous process, and requires anticipation of future conditions and careful planning of breeding programmes. In a multifactorial environment, and among increasingly heterogeneous consumers, it is a challenge to predict changes in consumption patterns and to arrange breeding programmes and livestock production activities accordingly. The priority attached to these processes by governments or public institutions also varies considerably between countries and regions, and between species.

2.1 Cattle

Breeding programmes for cattle have the highest priority and are implemented in the largest number of countries. Ninety-four countries (65 percent) of the 144 countries keeping cattle indicate that they see cattle breeding as a priority (Table 60), while 68 (47 percent) implement such programmes (Table 61). Countries from Africa, the Caribbean and Central America express the lowest priority for cattle breeding (excluding the Southwest Pacific). The greatest discrepancy between priority and actual implementation of breeding programmes is found in the countries of the Near and Middle East.

Among the 70 subsample countries, breeding goals have been specified for 22 percent of cattle breeds, and definitive strategies are being implemented for 19 percent of breeds (Table 62). Breeding strategies are less clearly specified in the countries of the Near and Middle East, and Latin America. Improvement of quantitative traits and increased production are mentioned by a large number of countries as the main breeding objectives for both dairy and beef cattle. Improved milk quality, efficiency of production, fertility and conformation traits are gaining an increasing importance in breeding programmes in Europe and the Caucasus. In Scandinavian countries, breeding for health traits has a high priority, and is achieved with the help of extensive recording programmes. Increasing product uniformity and consistency is

TABLE 60
Countries prioritizing breeding activities (by species)

	Cattle	Buffalo	Sheep	Goat	Pig	Chicken
	[percentage of countries]					
Africa	52	0	19	19	17	14
Asia	71	44	30	40	24	20
Near & Middle East	71	67	71	43	0	14
Europe & the Caucasus	90	18	67	54	69	23
Latin America & the Caribbean	55	14	23	9	9	14
Caribbean & Central America	42	0	17	8	8	8
South America	70	50	30	10	10	20
North America	100	0	50	50	100	50
Southwest Pacific	13	0	40	0	18	9
World	65	29	39	31	33	18

Based on information in the Country Reports.
Percentage of the countries that keep the respective species.

TABLE 61
Structured breeding activities for the main livestock species

	Cattle	Buffalo	Sheep	Goat	Pig	Chicken
	[percentage of countries]					
Africa	31	0	10	10	6	2
Asia	58	38	30	32	19	16
Near & Middle East	14	33	57	43	0	14
Europe & the Caucasus	74	9	59	54	62	23
Latin America & the Caribbean	36	14	23	9	9	14
Caribbean & Central America	17	0	17	8	8	8
South America	60	50	30	10	10	20
North America	100	0	50	50	100	50
Southwest Pacific	13	0	40	0	18	9
World	47	22	33	27	27	14

As mentioned in the Country Reports.
Percentage of the countries that keep the respective species.

an important objective for dairy cattle in North America, but more recently functional traits have been integrated into the selection index.

2.2 Buffaloes

Only 41 Country Reports indicate that buffaloes are kept. Of these countries, 29 percent mention buffalo breeding as a priority (Table 60) and 22 percent have breeding programmes (Table 61). In Asia, the main buffalo rearing region, the

TABLE 62
Strategies and tools used in cattle breeding

	World	Africa	Asia	Near & Middle East	Europe & the Caucasus	LAC*	Southwest Pacific
n	67	24	8	3	21	10	1
Total number of breeds							
Local	505	143	71	12	112	166	1
Exotic	476	143	34	10	159	125	5
Breeds with							
Breeding Goal	22%	18%	28%	14%	44%	4%	0%
Strategy Implemented	19%	13%	24%	9%	44%	1%	0%
Individual Identification	34%	11%	12%	9%	44%	58%	0%
Performance Recording	31%	12%	16%	9%	42%	45%	0%
Artificial Insemination	42%	23%	12%	23%	48%	69%	0%
Genetic Evaluation	22%	9%	12%	5%	38%	24%	0%
Breeds with system of use specified	544	113	24	5	151	246	5
Pure-breeding	27%	33%	42%	60%	44%	11%	20%
Cross-breeding	25%	36%	17%	20%	16%	26%	0%
Both	49%	31%	42%	20%	40%	63%	80%

Regional averages calculated on the basis of information from the subsample countries.
*Latin America and the Caribbean.
n = number of countries providing information.

figures are 44 percent and 38 percent, respectively. The main countries with breeding programmes for buffaloes are India, Pakistan, China, Egypt and Bulgaria, with milk yield being the main breeding objective.

2.3 Sheep and goats

Breeding programmes for sheep and goats are much less frequently seen as a priority than programmes for cattle. Breeding activities for sheep and goats are considered important by 39 percent and 31 percent, of countries respectively (Table 60). Thirty-three percent and 27 percent of countries actually have such programmes (Table 61). After Europe and the Caucasus, the largest number of countries with breeding programmes for small ruminants is found in Asia. The interest in breeding programmes for small ruminants in African countries is low, and only four countries have such programmes. Interest and implementation is also low in the countries of Latin America and the Caribbean. Information from the 70 subsample countries indicates that breeding goals and breeding strategies are developed for a larger proportion of sheep than goat breeds (see Annex Tables 68 and 69 for data from the different regions). Few countries report specific breeding objectives for small ruminants, but growth traits appear to have the greatest importance. Wool quality and production traits are decreasing in importance even in countries with sheep specialized for wool production. Improving dairy characters is the main breeding objective for goats in European countries.

2.4 Pigs

Pig breeding is considered a priority in 44 countries (33 percent, Table 60), but only 36 countries (27 percent) report the existence of structured breeding programmes (Table 61), and only ten of these countries are outside Europe and the Caucasus or North America. The discrepancy between the expression of priority and the actual existence of breeding programmes is, thus, much smaller than for cattle, but similar to that for small ruminants. Several Country Reports from Latin America and the Southwest Pacific indicate that genetic improvement of pig populations largely depends on the import of animals or semen. Systematic cross-breeding programmes, mainly involving three-breed crosses, have become the standard in nearly all countries with advanced pig production – 34 Country Reports indicate the existence of such systems. Among the 70 subsample countries, the number of pig breeds reported is much smaller than the number of cattle or small ruminant breeds (Annex Table 70). Breeding goals and breeding strategies have been specified for 35 percent and 30 percent of the breeds, respectively, but the proportion is more than twice as high in Europe and the Caucasus as in the other regions. The number of specific local breeds reported is much smaller than for ruminants, while a few international breeds, such as Landrace, Large White, Duroc, Hampshire and Yorkshire, have a very wide distribution. Important objectives of the reported breeding programmes include fertility, feed conversion rate, and proportion of lean meat production. According to many Country Reports, pigs of the lard type have largely lost their former importance.

2.5 Poultry

Of all the major livestock species, chickens have the lowest number of countries indicating that breeding programmes are a priority (Table 60), and the lowest number of countries having such programmes (Table 61). Chicken breeding activities, both for layer and broiler breeds, are largely carried out by a few transnational breeding companies, which market their products worldwide. Very few countries report structured breeding activities for other poultry species such as turkeys (five countries), ducks (eight countries) and geese (four countries). The low importance of chicken breeding programmes in most countries is reflected by a low proportion of breeds with a specific breeding goal (13 percent) and breeding strategy (11 percent). The proportion of breeds with breeding strategies is larger in Europe and the Caucasus than in the other regions (Annex Table 71). The Country Reports provide no specific information about breeding objectives for poultry.

2.6 Other species

Systematic breeding programmes for horses are mentioned in 31 Country Reports (Annex Table 72). This may not reflect the full extent of planned breeding activities for horses, especially those that are maintained for sports and racing. Horse breeding is characterized by a significant international exchange of breeding material. In most European countries, the majority of horses are now bred for the leisure activities of amateur riders. Other reasons for keeping horses are meat production and work – especially cattle herding in South America which utilizes large numbers of horses. Among the 44 countries that report the keeping of camelids, two countries in Asia have breeding programmes for dromedaries, and Argentina has a programme for llamas. Among 108 countries that mention rabbit production in their Country Reports, 26 have significant production, but only five mention systematic breeding programmes. This figure does not include the large number of organized hobby breeders of rabbits, found particularly in Europe and the Caucasus.

It is reasonable to assume that the majority of countries that do not report the importance or existence of breeding programmes for a given species in their Country Reports do not have such programmes. Moreover, there are also many indications that the population involved in most

existing breeding programmes in African and Asian countries is rather small. The results of the review, thus, indicate that except for cattle, the majority of countries do not have their own structured breeding programmes and do not yet consider them a priority.

3 Organizational structures

Structured breeding programmes require organization to enable systematic performance recording, planned mating and genetic evaluation. These activities are carried out through government and non-governmental structures or a combination of the two. Breeding programmes that are directly implemented by government institutions include those carried out on state breeding farms and at research institutes and universities. Non-governmental stakeholders that implement breeding programmes include breeding organizations and private companies.

The majority of systematic breeding activities for cattle and small ruminants in the countries of Africa, Asia, and the Near and Middle East are implemented by government institutions, while in western Europe, breeding organizations have the greatest importance (for details see Annex Tables 73 to 76). Most of the government breeding programmes in Africa, Asia, and the Near and Middle East are carried out through nucleus herds/flocks on state farms. The animals and semen produced are then distributed to the general population. There is, therefore, no active participation by the livestock keepers in the breeding process. These programmes are often implemented with no monitoring of the influence of the breeding activities on the general livestock population. Only a few countries in these regions have government breeding programmes that involve the direct participation of the breeders. Examples include buffalo breeding programmes in India and Pakistan, and sheep breeding programmes in Tunisia and Côte d'Ivoire.

TABLE 63
Training, research and farmers' organizations in current policies

	Africa		Asia		Near & Middle East		Europe & the Caucasus		Total	
	n	Score	n	Score	n	Score	n	Score	n	Score
Training & Research										
Cattle	21	**3.4**	7	**3.6**	3	2.7	15	**3.5**	46	**3.4**
Sheep	21	3.2	7	2.3	4	**2.8**	16	3.3	48	3.1
Goats	20	3.1	7	2.4	4	2.3	16	2.5	47	2.7
Pigs	19	3.0	5	2.6			14	3.3	38	3.1
Chickens	21	3.2	7	2.7	5	2.4	15	3.0	48	3.0
Organizing Farmers										
Cattle	21	**3.1**	7	**3.4**	3	2.3	15	**3.2**	46	**3.1**
Sheep	21	2.8	6	1.8	4	2.5	16	**3.2**	48	2.8
Goats	20	2.7	6	2.0	4	2.0	16	2.7	46	2.5
Pigs	19	3.0	4	2.8			14	3.1	37	3.0
Chickens	21	**3.1**	6	3.0	5	**3.2**	14	3.1	46	**3.1**

Information from the subsample countries (excluding Latin America and the Caribbean, and the Southwest Pacific).
n = number of countries providing information.
Scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) indicate the importance given to the activity in current policies. Average scores for each region are shown, with highest scores for each region in bold.

Joint implementation of breeding programmes by the governmental and non-governmental sectors often indicates a transitional phase from government breeding programmes to an increased involvement of private breeders and breeding organizations. The Country Reports show that efforts to establish breeding organizations for cattle are considered important in many countries, but other species are given less priority (Table 63). Such developments are taking place in a few African and Asian countries, and particularly in the former centrally planned countries of eastern Europe. It seems likely that in countries whose reports do not indicate the organizational structures of their breeding programmes, governmental and non-governmental institutions have shared responsibilities. Direct involvement of government institutions in breeding programmes has been systematically reduced in most western European countries, and no longer exists in North America. Active participation of individual breeders is an important characteristic of the programmes in these regions. Private breeding programmes (both through breeding organizations and companies) are highly developed for pigs. In poultry, a few transnational companies have a dominating role.

Breeding programmes in South America are largely implemented by breeding organizations, but are supported in several countries by government agencies or research institutes. In addition to breeding organizations that implement systematic breeding programmes, most South and Central American countries have a large number of breeders' organizations. These breeders' organizations, especially for cattle and horses, register pedigree information for animals of specific breeds, but systematic performance recording and genetic evaluation are rare.

The involvement of the different stakeholders (government, breeders and research) in breeding activities is an important indicator for the characterization of breeding programmes. Table 64 summarizes information provided by the subsample countries (note that Tables 63 and 64 do not include data from Latin America and the Caribbean, or the Southwest Pacific, as no countries from these regions utilized the relevant predefined tables). In all regions except western parts of Europe and the Caucasus, breeding goals are largely determined by research institutions and their staff, to a lesser extent by government institutions, and only marginally by the breeders themselves. Similar circumstances are reported for other aspects of breed development such as individual identification, recording and genetic evaluation (Table 64). In particular, breeders in the countries of Africa and the Near and Middle East appear to have a limited role in influencing breeding activities organized and implemented by government institutions. In combination with a lack of follow-up activities, this lack of participation by the livestock keepers means that there is considerable risk that breeding efforts will have limited success or even fail.

For all species, but most frequently for small ruminants and poultry, breeding activities are also implemented by national and international NGOs. These activities often consist of the distribution of small numbers of breeding stock, frequently of exotic breeds to "upgrade" the local population. No systematic information is provided in most County Reports about the impacts of these initiatives, but there are indications that they are not significant. Exceptions are probably the large-scale implementation of AI programmes for cattle and buffaloes by NGOs in the countries of South Asia.

In countries with active breeding programmes, international competition is leading to concentration in fewer, bigger schemes, with fewer breeding organizations. This process is most advanced for the poultry industry, but is also occurring in dairy cattle and pig breeding. To compete in the international market, Scandinavian countries have developed joint breeding activities, and Germany and Austria jointly implement the estimation of breeding values for dairy cattle. The standardization of international genetic evaluations for cattle through the International Bull Evaluation Service (INTERBULL) is also promoting the implementation of breeding

TABLE 64
Stakeholder involvement in the development of animal genetic resources

	Total	Africa	Asia	Near & Middle East	Europe & the Caucasus
Breeding Goals	48	21	7	4	16
Governments	3.0	3.1	3.1	**3.0**	2.8
Breeders	2.4	1.9	2.4	1.5	3.2
Research	**3.4**	**3.3**	**3.4**	**3.0**	**3.6**
NGOs	2.2	1.9	1.8	**3.0**	2.6
Individual Identification	45	19	6	4	16
Governments	2.7	2.2	**3.0**	**1.8**	**3.4**
Breeders	2.4	1. 9	2.3	1.3	**3.4**
Research	**2.8**	**3.1**	**3.0**	**1.8**	2.8
NGOs	1.8	1.7	1.4	1. 7	2.0
Recording	48	21	6	4	17
Governments	2.5	2.3	**2.8**	1.8	2.9
Breeders	**2.6**	2.0	**2.8**	1.5	**3.5**
Research	3.0	**3.4**	2.7	1.5	2.8
NGOs	2.0	2.1	1.6	**2.3**	2.0
Genetic Evaluation	45	17	7	4	17
Governments	2.1	1.8	2.6	1.3	2.4
Breeders	1.8	1.4	1.4	1.0	2.5
Research	**3.1**	**2.7**	**3.1**	**2.0**	**3.8**
NGOs	1.6	1.3	1.8	1.3	1.9

Information from the subsample countries (excluding Latin America and the Caribbean, and the Southwest Pacific).
Number of countries providing information and average scores for stakeholder involvement for each region.
Scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) based on thorough analyses of data available, to indicate the role of involvement of each stakeholder in the implementation of tools that support the development of AnGR. Highest scores for each region are shown in bold.

programmes beyond national borders. Genetic improvement of pigs and Holstein-Friesian dairy cattle in South and Central America is largely achieved through imports of semen from North America, or Europe and the Caucasus. There are concerns expressed in the Country Reports that the increased internationalization of dairy cattle breeding may lead to negative effects with regard to the adaptation of the cattle population to specific local conditions.

4 Tools and implementation

Collection of performance data, analysis of the data for the identification of superior animals, and use of these superior animals to produce the next generation, are the main components of structured breeding programmes. Among the countries with structured breeding programmes, and among the different species, the scale and use of these tools varies significantly. With the exception of a few Latin American countries

(Argentina, Brazil, the Bolivarian Republic of Venezuela and Mexico) and India, the large-scale collection of performance data from individual livestock owners for breeding purposes is largely restricted to Europe, North America and Australia.[7] On a smaller scale, collection of performance data from individual small ruminant flocks is carried out in some North and West African countries.

Most Country Reports from Africa and Asia provide very limited information about the active breeding population. However, in addition to the small proportion of breeds included (Table 62, Annex Tables 68–71), the active breeding population is probably very small. The other extreme is represented by a country such as Norway, where more than 95 percent of all dairy cows are covered by a recording scheme.

While best linear unbiased prediction (BLUP) programmes for the estimation of breeding values are the standard for all countries with advanced breeding programmes, no information is provided in the Country Reports about selection methods used in the nucleus herds/flocks kept on governmental farms. Selection of animals by phenotypic characteristics probably still has an important role on these farms. Extensive datasets with BLUP "test day" models allow increasingly good prediction of breeding values in intensive dairy cattle breeding programmes.

Planned breeding requires controlled mating. As a large proportion of the grazing livestock in low and medium-input production systems are kept under conditions of uncontrolled mating, planned breeding for these animals is difficult. Such systems are very common in African and Latin American countries. CR Ecuador (2003), for example, reports 49 percent uncontrolled mating for cattle, 81 percent for sheep, and 61 percent even for pigs. In addition to the use of improved males, AI is used in many countries as a tool for controlled mating. One-hundred and fourteen countries (77 percent) reported the use of AI in cattle, 18 percent in sheep, 7 percent in goats and 32 percent in pigs. Use of AI in cattle is common in all regions, for the other species it is more common in Europe and the Caucasus, and the Americas (Table 65). The greater importance of AI for cattle is also reflected by a higher proportion of breeds included in the programmes (Table 62, Annex Tables 68–71) and the number of inseminations performed. By all these criteria, AI for pigs has the second highest importance. Both locally produced and imported semen is used for AI. The high proportion of cattle breeds used in cross-breeding schemes (Table 62) may indicate that a considerable amount of the semen used in countries without advanced breeding programmes is imported or from exotic breeds. In Latin America, AI of pigs also relies largely on imported semen.

Locally adapted and exotic breeds are used in both pure-breeding and cross-breeding systems. The information in Table 62 and Annex Tables 68– 71 shows the relative importance of these two breeding systems for the different species, based on the data provided by the 70 subsample countries. Pure-breeding is the most common breeding system in sheep only, while for the other species, cross-breeding or a combination of both are more frequent. The tables also show that exotic breeds play a significant role in many countries. Systematic cross-breeding programmes are common in advanced production systems for pigs and for beef cattle. A very large proportion of cross-breeding activities for all species in African, Asian and South American countries are, however, undertaken without a systematic programme.

The information in Table 66, based on the data provided by the subsample countries (excluding those from Latin America and the Caribbean and the Southwest Pacific which did not utilize the relevant predefined tables), indicates that current government policies favour the use of locally adapted breeds of cattle and small ruminants, but exotic breeds of pigs and poultry. This

[7] New Zealand, another country with an important livestock industry and breeding programmes, did not submit a Country Report and is, thus, not included in the analysis.

TABLE 65
Number of countries reporting the use of artificial insemination

Regions	Cattle	Sheep	Goat	Pig
Africa	31	2	1	1
Asia	17	4	2	8
Near & Middle East	4	0	0	0
Europe & the Caucasus	38	16	8	23
Latin America & the Caribbean	21	8	8	13
Caribbean & Central America	11	2	4	7
South America	10	6	4	6
North America	2	0	1	1
Southwest Pacific	5	1	1	4
World	**118**	**31**	**21**	**50**

TABLE 66
Importance of species and locally adapted versus exotic breeds in current policies

	Africa		Asia		Near & Middle East		Europe & the Caucasus		Total	
	n	Score	n	Score	n	Score	n	Score	n	Score
Cattle										
Locally adapted breeds	21	3.9	7	3.1	3	2.0	14	3.5	45	3.5
Exotic breeds	21	3.1	7	3.7	3	3.0	15	2.4	46	3.0
Sheep										
Locally adapted breeds	21	3.8	7	2.4	4	3.3	16	3.4	48	3.4
Exotic breeds	21	1.9	6	2.2	4	2.5	16	1.8	47	2.0
Goat										
Locally adapted breeds	20	3.8	7	2.7	4	2.5	15	3.1	46	3.3
Exotic breeds	19	2.0	5	2.2	4	2.0	15	1.6	43	1.9
Pig										
Locally adapted breeds	19	3.4	5	2.2			13	2.8	37	3.0
Exotic breeds	18	3.2	4	4.3			14	2.9	36	3.2
Chicken										
Locally adapted breeds	21	3.4	7	3.0	5	2.4	14	2.2	47	2.9
Exotic breeds	21	3.4	6	4.0	5	3.6	15	2.9	47	3.3

Information from the subsample countries (excluding Latin America and the Caribbean, and the Southwest Pacific).
n = number of countries providing information; score = average score for region.
Scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) indicate the extent to which current policies support the use and development of the respective AnGR.

situation clearly reflects the efforts to intensify pig and poultry production and the need for breeds with higher productive capacity. Efforts to increase dairy production make exotic cattle more popular in Asian countries than in Africa. The information provided by the subsample countries also shows that exotic breeds of sheep and goats are not considered a priority by most countries (Table 68).

While several countries encourage the use of certain species and breeds through support and development efforts, direct influence on the choice of breed or breeding system used by the livestock owners is rare. In most countries, there are government regulations that control the import of semen and animals, including breeding stock, for animal health reasons. Requirements for direct approval by the authorities and specific quality criteria for male breeding stock exist only in a few European countries. In order to conserve and protect specific local dairy breeds, regulations were issued in India and Pakistan which should have prevented cross-breeding with exotic cattle breeds. However, in practice these regulations could not be enforced.

5 Overview of breeding programmes by region

In most countries, production conditions and demands for livestock products have changed considerably during recent decades – accelerated by increasing urbanization. Depending on the type of country, these developments comprise increased demand, changing demands with respect to product quality, and shifts in demand between different livestock products. In different countries, government authorities, breeding organizations and livestock owners have reacted in different ways to these changes and challenges. The ways in which breeding interventions have contributed to the change also show considerable variation between countries, regions and species. This variation is highlighted in the following regional reviews.

5.1 Africa

Cattle are the most important livestock species in Africa, and 45 percent of countries expressed the need for intensification as their priority policy. To achieve this target, 26 percent of countries favour breed improvements for local breeds, 55 percent favour cross-breeding with exotic cattle, and 17 percent favour direct introduction of exotic cattle. These figures are also an indication of the nature of past and ongoing breeding efforts.

Development of local breeds is mentioned as a priority only by West African countries, while introduction of exotic cattle is mentioned by North African countries. The popularity of local breeds in West Africa is largely influenced by efforts to breed, improve, and in several countries to introduce, the trypanotolerant N'Dama breed. In order to improve production, however, farmers increasingly cross N'Dama with Zebu breeds or even with Holstein-Friesians. The establishment of peri-urban dairy production has led to the introduction of Holstein-Friesian cattle or their cross-breeds in many African countries. Several other exotic breeds have been tried in Africa, but among these only the Brown Swiss (in North Africa) has remained of any significance. In a large number of African countries, local cattle are kept on government stations, and breeding stock distributed to livestock owners. The Country Reports indicate that the number of breeding stock distributed is probably small and without significant effect on the general population. Government cross-breeding efforts in the countries surveyed have had almost no success in the development of specific new breeds. Lack of organizational structures and the nature of the production and breeding systems, have favoured unsystematic cross-breeding as the most common means of genetic improvement.

Intensification of sheep production is seen as a priority by only 19 percent of African countries. The figure for goat production is even lower, at 10 percent. Improvement of local sheep breeds is considered as important by 10 percent of countries and of local goat breeds by 5 percent. Seventeen percent of countries favour cross-breeding for both species. Successful breed developments

among farmers' flocks have been implemented in some countries of North Africa.

An open nucleus breeding scheme with Djallonké sheep in Côte d'Ivoire has encouraged several similar schemes in other West African countries, but most have not been realized. Maintaining a relatively pure Merino breed for wool production has been a government priority in Lesotho, but enforcement of this policy has been weak. Dorper sheep have been introduced for cross-breeding with local sheep in several countries, but cross-breeding for sheep has not, overall, achieved the same importance as for cattle. The same applies in the case of goats, in which cross-breeding with European dairy breeds has not proved successful, and has recently been replaced by cross-breeding with the Boer breed for meat production. Some African countries keep local breeds of small ruminants on government stations, but as in the case of cattle, there is little influence on the general livestock population.

Intensification of chicken production is considered a priority by 36 percent of African countries and intensification of pig production by 17 percent. No recent breeding efforts for chickens are reported, and in most countries intensification relies on imported commercial hybrids. Intensification of pig production is largely done through cross-breeding

Box 24
Research and breed development in Africa

In Nigeria, a lot of investment was, in the past, made in the import and use of exotic AnGR for research purposes and for breed improvement, especially on government farms. The results of these initiatives have been mixed. In terms of research, the results have been positive but in terms of breed improvement there have been no significant gains.

Similarly in Ghana, exotic cattle such as Friesians, and Sahiwal were imported from Europe and India, respectively; and breeds such as N'Dama, White Fulani and Adamawa Gudali were imported from within the West Africa subregion. Various crosses were made with the West African Shorthorn. The Ghana Sanga is the only successful breed developed from the programme. The University of Ghana undertook cross-breeding of Sokoto Gudali and Ghana Shorthorn with Jersey and later with Friesian cattle to develop a milking animal. Most of the breeding programmes were hampered by lack of human resource, finance, disease outbreaks and other logistical problems.

In Côte d'Ivoire, cross-breeding between N'dama and Jersey started at the Centre de Recherches Zootechniques de Bingerville in 1962 and continued for 15 years. The objective of the work was to create a dairy breed adapted to the climatic conditions and husbandry in Côte d'Ivoire. No testing of the cross-breeding concept under farm conditions had been initiated when the programme was terminated due to financial problems in 1977.

Sources: CR Côte d'Ivoire (2003); CR Ghana (2003); CR Nigeria (2004).

Box 25
Sheep breeding in Tunisia

In Tunisia, a national programme for the genetic improvement of sheep is implemented through 236 selected flocks. The growth performance of lambs is monitored through a process of six weighings, which form the basis for the selection of future breeding stock. This programme is entirely financed by the state, but proposals have been made to reduce costs and increase the involvement of the sheep owners through the establishment of breeders' associations. The present model of genetic evaluation is uniform and offers no choice to the stockbreeders – although they operate under varying production conditions and have varying production objectives. The large number of weighings is also a burden for the breeders. More flexibility and cooperation with the breeders has the potential to reduce costs, and increase the capacity and efficiency of the programme.

Source: CR Tunisia (2003).

with exotic breeds, or through direct use of these breeds in more intensive production systems. No breeding programmes for local pigs are reported from African countries.

5.2 Asia

In Asia, 56 percent of countries express the need for intensification of cattle production as their priority policy, with the same percentage favouring cross-breeding with exotic breeds, and 20 favouring direct introduction of exotic cattle. In fact, both approaches have been followed on a large scale. Extensive cross-breeding with exotic breeds, primarily Holstein-Friesians, has occurred in the Islamic Republic of Iran and the countries of South Asia, while the direct introduction of large numbers of exotic cattle has been the chosen approach in countries with newly developing dairy industries in Southeast and East Asia. CR Islamic Republic of Iran (2004) reflects these changes, and indicates an increase in the proportion of cross-bred cattle in the country from 11 percent to 35 percent during the period from 1995 to 2003. In Central Asian countries, the change of ownership from government and cooperative farms to individual owners has caused a reduction in animal numbers, and has prevented systematic breeding efforts.

The development of local breeds through pure-breeding is considered important for buffaloes, but not for cattle. Both cattle and buffaloes are still important for draught purposes, for which local breeds are utilized. In most Asian countries, dairy production is developing as the main purpose of cattle production. Cross-breeding with specialized beef cattle breeds has been carried out in Southeast Asian countries, especially for plantation grazing systems. Several Asian countries have established systematic breeding programmes either on government farms, or directly with livestock owners, both for introduced specialized dairy breeds and for new composite dairy breeds. However, the number of bulls selected through progeny testing is often small, and the import of semen is, therefore, important in many Asian countries. Examples of systematic efforts to develop composite breeds include the Sunandini in India and the Mafriwal in Malaysia. Active promotion of the general infrastructure for cattle development, including marketing facilities, has had a positive effect on breed development efforts.

The importance of sheep and goat production varies greatly between the different parts of the region. Sheep production is important in some countries of Central and South Asia, but overall more countries consider intensification important for goat production (12 percent) than for sheep

Box 26
Buffalo breeding in India

In India, buffaloes are becoming the species of choice among large ruminants, favoured by price incentives for milk with higher fat content. The recommended state development policy was laid down in the mid-1960s and envisaged selective breeding of Murrah buffaloes, and the use of Murrah to grade up non-descript buffaloes. Central and state governments and the private sector have established 33 breeding farms in different parts of the country, which follow a scientific breeding policy and act as multiplication centres for production and dissemination of superior bulls. Progeny testing schemes have been initiated in institutional herds and among farmers to test superior Murrah and Surti bulls on the basis of the performance of their progeny rather than only on the basis of the dam's yield. Field progeny testing programmes supported by the government, cooperative dairies, research institutes and NGOs, however, lack the necessary performance recording. Most ongoing progeny testing programmes are, therefore, dependent on institutional herds, and exclude good animals kept by the farming community. The number of bulls tested and selected is also too small to make any appreciable impact on genetic improvement.

Source: CR India (2004).

production (4 percent). Substantial efforts were made to develop fine wool production by crossing local breeds with Merino-type sheep in Central Asian countries, India and Pakistan. However, poor demand for wool and the problems involved in producing sufficient quantities of good quality wool contributed to the limited success of these efforts and the return of livestock owners to their traditional breeds. In other Asian countries, breeding efforts for sheep production have also lacked success, which may explain the low priority given to future intensification of sheep production. Indian and European goat breeds have been utilized in East and Southeast Asian countries for cross-breeding with the local population and new composite breeds have been established in Malaysia and the Republic of Korea. In the latter country, extensive cross-breeding work was done with Boer and Australian Feral goats for increased meat production. Although local goat breeds are maintained in various Asian countries on government farms, no specific breed development activities are mentioned in the Country Reports.

Box 27
Goat breeding in the Republic of Korea

Goats have been well adapted to the Korean Peninsula for more than 700 years. In addition to normal consumption, goat meat has long been regarded as a health or medicinal food. With increasing demand for goat meat in the early 1990s, Boer and Australian Feral goats were imported, and widely used for cross-breeding with the native Black Goats. Even though the Boer cross-breeds had a better growth rate than the native goats, they were not popular with the farmers because they did not have the same black coat colour as the local goats. This prompted the importation of goats from the Black Australian Feral breed, which has the same colour as the native animals. Saanen goats were also imported and widely distributed as a dairy breed, but competition from cow milk caused a drastic reduction of numbers. Recently, however, growing demand for goat milk has again led to the import of new breeding stock.

Source: CR Republic of Korea (2004).

Box 28
Duck breeding in Viet Nam

Viet Nam has the second largest duck population in the world. There are eight local duck breeds and an equal number of breeds have been introduced from other countries for pure-breeding and cross-breeding. Duck breeding is organized by the National Institute for Animal Husbandry through two duck breeding centres, which keep and develop grand-parent and parent stocks, and distribute breeding material to local producers. This pyramid breeding structure has significantly improved duck breeding in Viet Nam, and is considered as a model that can be applied to other livestock breeding systems in the country.

Source: CR Viet Nam (2003).

Pigs are the most important livestock species in Southeast and East Asia, and poultry, especially chickens, are important throughout Asia. Intensification of chicken production is considered a priority by 48 percent of Asian countries, and of pig production by 29 percent. Breeding activities are largely focused on intensive production conditions, and include systematic cross-breeding programmes and the use of hybrids produced and marketed by commercial companies. The use of imported breeding stock is mentioned by all Asian countries that are interested in intensification as priority, and 14 percent mention cross-breeding as the preferred approach. In China and Viet Nam, the biggest pig producers, breeding activities are carried out through governmental nucleus breeding programmes, but both countries also import exotic breeding stock. While local pig breeds are still popular in Viet Nam, more than 50 percent of the population is already cross-bred, and the government is further promoting a "leanization programme" with exotic breeds. In

India, China and Viet Nam, breeding stock for the intensive broiler and layer industry, and for duck production systems, is produced by government institutions and independent private companies. However, the countries' markets are also supplied by a small number of international breeding companies, which in other Asian countries have become the exclusive suppliers.

5.3 Europe and the Caucasus

Development of livestock production and breeding activities in western European countries is largely influenced by the Common Agricultural Policy (CAP) of the EU, which also determines the structure of breeding activities. These structures are also adopted by the new EU members in central Europe, and influence the non-EU countries in western Europe. Breeding structures in eastern European countries still largely reflect the state structures that existed under centrally planned economies – and in some cases reflect the collapse of these structures. In most western European countries, governments have withdrawn from active involvement in breeding activities and their role is now limited to the supervision of breeding organizations and companies. In eastern European countries, breeding activities are carried out through licensed "pedigree farms" – large state or former state farms, which are under the control of research or university institutes. A common market for semen and breeding stock leads to extensive trade and international competition between national breeding companies and breeding organizations. In addition to utilizing their own breeding stock, eastern European countries increasingly import semen and breeding stock.

Cattle breeding has come to focus on single-purpose breeds, with the Holstein-Friesian being the dominant breed in most European countries. In parallel, beef production from suckler cows has developed, either utilizing specialized beef breeds or commercial cross-breeds from out of the dairy herds. Intensive breeding programmes using the BLUP procedure, and the wide use of a small number of elite dairy sires, have achieved significant genetic progress, but also risk increased inbreeding and a reduction in genetic diversity in the main cattle breeds. Regular monitoring of the degree of inbreeding has, therefore, been included in the breeding programmes of several countries. Difficulties in controlling the degree of inbreeding also exist in the case of rare breeds with small population sizes.

The number of breeding organizations is decreasing, while the average population size of the remaining ones increases. Governed by market forces, livestock breeding is undergoing a shift from national cooperatives to international companies. Livestock farmers choose breeding stock from these breeding programmes for the superior economic qualities of their products, leaving less opportunity for local breeding programmes. In addition to production characteristics, selection is now focusing on a wider range of attributes, with health, well-being and life expectancy increasingly included in the breeding objectives. In the Nordic countries, specific importance is given to fertility traits, calving and disease resistance, with the Norwegian Red (NRF)[8] and the Swedish Red and White breeds as particular examples. The specific breeding objectives implemented in the NRF have meant that breeders see semen from this breed as a viable alternative to that produced by the large, international breeding companies.

In Europe and the Caucasus, the breeding of small ruminants is generally less organized than that of cattle. The collapse of the wool market has redirected breeding objectives in all countries towards meat production through cross-breeding and breed substitution. Dairy performance is an important breeding objective for goats and some sheep in southern Europe. In many European countries sheep and goats are still kept by traditional farmers who do not participate in structured breeding activities.

The breeding of pigs and poultry in Europe and the Caucasus is dominated by the production of hybrids through systematic cross-breeding schemes.

[8] Norsk Rødt Fe

Box 29
Pig breeding in Hungary

In Hungary, pig breeding is the most important branch of livestock breeding. Based on the local Hungarian Large White and Landrace breeds, together with some other imported breeds, Hungary was among the first countries in Europe to start the breeding of hybrids in the 1970s. Today, three Hungarian hybrids are recognized, have the highest share of the local market, and can compete with the best foreign hybrids. The old lard-type pig has been almost completely replaced – except for the Mangalitsa breed which has gained popularity and increased numbers because of the unsaturated fatty acids in its fat.

Source: CR Hungary (2003).

Box 30
Horse breeding – tradition and new requirements

In the Czech Republic, the Old-Kladruby horse is a warm-blood breed, based on old-Spanish and old-Italian blood, which has been bred in the country continuously for more than 400 years. In 1995 this breed was recognized as part of the Czech Republic's national cultural heritage.

In Poland, the horse population is gradually decreasing and their importance as a source of draught power in the fields has been substantially reduced. With the increased opportunities to export horses for slaughter, some farmers are changing to the heavy built, cold-blooded type. However, there is also a growing interest in horses of various breeds and types for recreational uses such as agro-tourism, cross-country rallies, riding holidays and "hippo therapy".

Sources: CR Czech Republic (2003); CR Poland (2002).

While in the pig sector, breeding organizations and commercial companies continue to compete, and have different market shares in different countries, poultry breeding (with the exception of some east European countries) is dominated by transnational companies.

5.4 Latin America and the Caribbean

As a result of the varying ecological conditions, the livestock production systems in the countries of South and Central America and the Caribbean are very diverse. Cattle have the greatest importance in most countries, but development efforts during the last decade have concentrated more on pig and poultry production, and the relative importance of cattle has declined in some countries. Brazil is by far the most important country for livestock development in the region, not only as the country with the biggest commercial cattle population, but also having several advanced breeding programmes that cover a large population. Breeding efforts for cattle are focused on beef production traits such as reproductive efficiency and growth rate – especially for the Nelore which is the dominant breed in the country. There are also efforts to improve dairy characteristics for some composite breeds and for Holstein-Friesians. Semen and breeding animals from the Brazilian programme are also utilized in other South and Central American countries, but it is reported that intensive use of a limited number of elite sires risks a considerable reduction in genetic variability.

Active breeding programmes using BLUP animal models exist for Zebu cattle in the Bolivarian Republic of Venezuela, and for Holstein-Friesians in Argentina and Mexico. However, as most countries do not have their own breeding programme and semen production, imported semen from Holstein-Friesians and other European dairy and beef breeds is widely used in the region. In many countries, extensive cross-breeding with Zebu cattle is reducing the population of the local Criollo breeds. Unsystematic rotational crossing involving Zebu breeds such as the Brahman, and European beef breeds or Criollos, is also widely practised. Several composite dairy breeds have

been developed in Brazil, Cuba and Jamaica. Many separate breeders' associations exist for all important breeds in most countries of the region. These associations keep pedigree registers often with a long tradition. Their involvement in modern breeding practices based on performance records is, however, less common.

Utilizing genetic material from Australia and New Zealand, Argentina has a large wool breeding programme for Merino and Corriedale sheep, which is implemented by breeding organizations. In other countries of the region, structured breeding of sheep and goats largely consists of cross-breeding programmes with the introduction of various exotic breeds. The exotic sheep breeds being used are numerous and range, depending on the ecological conditions, from the Corriedale and Rambouillet breeds for the High Andes, to British meat breeds in Chile, and hair sheep such as Barbados Black Belly and Pelibüey in the tropical costal regions. Breeding programmes for the latter two breeds are reported from their original locations in Barbados and Cuba. Cross-breeding programmes for sheep have largely been implemented by government or international development programmes. However, countries do not have planned breeding activities for Criollo sheep. Genetic development of goats through cross-breeding programmes is carried out with a variety of European dairy goat breeds (Saanen, Toggenburg, Alpine, Anglo Nubian) and Boer goats, and is frequently implemented by NGOs. Breeding of goats for dairy performance utilizing BLUP procedures has been carried out for a few years in one Mexican state.

Breeding development for pigs and poultry in Latin America and the Caribbean is mainly carried out by companies that produce hybrids. Use of imported semen and breeding stock from outside the region is widespread. In pigs, three-breed crosses are common under intensive production conditions. Cuba is an exception, and has government breeding programmes for both species. The region has large numbers of horses, and there are breeders' organizations for specific breeds in many countries. However, no details are provided in the Country Reports about their activities. Unique to the region are government breeding programmes for llamas in Argentina, and guinea pigs in Peru. Several countries expressed interest in promoting planned breed activities for fibre characteristics and meat production in South American camelids, but these have yet to materialize.

Box 31
Beef cattle breeding in Brazil

Brazil at present has the largest commercial cattle population in the world. There are approximately 16 breeding programmes for the beef sector, of which all but one are for Zebu cattle. Thirteen programmes for different breeds and groups of breeds have the objective of increasing reproductive efficiency and growth rate in beef herds using classical breeding techniques allied with modern biotechnologies.
The top 20 percent of the animals receive a Special Certificate of Identification and Production (CEIP).
The Breeding Programme for Zebu Cattle (PMGZ), run by the Brazilian Association of Zebu Breeders (ABCZ) identifies superior animals by calculating expected progeny differences (EPDs) for weight and weight gain at different ages, as well as fertility traits and reproductive efficiency. With a database of more than 1.5 million animals and 65 000 new animals entering each year, this is a national programme for all Zebu breeds. Another breeding programme for Zebu cattle is GENEPLUS, which has a database of more than 700 000 animals and provides breeders with EPDs for age at first calving, calving interval, gestation period, service period and scrotal circumference, as well as weights and weight gains at different ages.
PROMEBO operates a programme for beef cattle of taurine breeds. With the aim of improving Zebu cattle, the ABCZ also collaborates with various research societies as well a dozen universities, offering them production and genealogy data.

Source: CR Brazil (2003).

PART **3**

Box 32
Breeding llamas in Argentina

In Argentina there are approximately 200 000 llamas. Systematic breeding of llamas is carried out at the INTA (Instituto Nacional de Tecnología Agropecuaria) research station at Abra Pampa which keeps an elite flock of about 600 animals divided into of three groups having white, brown and mixed coat colours respectively. Selection of the white group is for fibre production and quality, of the brown group for meat and fibre production, and of the mixed group for meat production only. Improved breeding stock has been distributed from the institute to approximately 2 700 breeders.

Source: CR Argentina (2003).

5.5 Near and Middle East

For the Near and Middle East, 43 percent of the countries submitting a Country Report indicate intensification of cattle and poultry production as their priority. Although an important sheep rearing region, no countries mention intensification of the species as a priority, and only 14 percent mention intensification of goat production as a priority. Cross-breeding of cattle and the use of exotic poultry are a priority for all intensification efforts, and 29 percent of countries regard the direct introduction of exotic cattle as a priority.

Large numbers of Holstein-Friesian cattle for dairy production have already been imported to the region and this process may continue. The further genetic development of these populations depends exclusively on the import of semen. Cross-breeding of local cattle using exotic semen is widespread, and is planned to continue, while no genetic improvement programmes are envisaged for the local cattle breeds. Genetic development of buffaloes is a priority for Egypt. Breeding activities for sheep and goats are reported from research institutes and government stations, but with limited impact on the general population. There are no ongoing or planned activities for poultry breed development in the region, and the poultry industry depends exclusively on material from transnational companies. Although their role is decreasing, camels are still important livestock in several countries of the Near and Middle East. Reference is made in the Country Reports to government breeding stations for camels, but no details about breeding objectives or the impact of these activities on the general population are provided.

5.6 North America and Southwest Pacific

Among the countries of the Southwest Pacific region that submitted Country Reports, only Australia has structured breeding activities. In the majority of the small island states of the region, pigs and poultry are the most important livestock species; genetic improvement is exclusively based on imports.

In Australia, Canada and the United States of America, breeding programmes are implemented for all species of livestock, and have gained worldwide importance through extensive exchange of semen and breeding stock. The programmes in these countries are implemented by breeding organizations and large companies, while government retains only a minor role. The animal breeding sectors in all three countries have responded very effectively to demands for increased production by applying selection pressure to certain high-yielding breeds. Pure-breeding for dairy cattle, and structured cross-breeding schemes for beef cattle, sheep and pigs, applied through highly effective programmes, are the most common breeding methods.

In the United States of America, selection for increased milk production is a priority for the dairy industry, but there is also a growing interest in multiple-trait selection for characters such as disease resistance or structural soundness. Intensive recording programmes and selection have been used to choose animals that produce the standard commodity in the most efficient manner in a largely controlled industrial environment. Selection intensity and reproductive

Box 33
Influence of market forces on livestock breeding in the United States of America

In the United States of America, market forces are a major influence on the utilization and conservation of AnGR. In the industry, there is a continuing drive for product uniformity and production efficiency. As the sector has become more industrialized, there have been greater efforts to increase the uniformity and consistency of the products. Part of this process is the identification of breeds, lines and stocks that meet a pre-specified set of product quality and biological performance standards, which enable the industry to meet consumer demands and control production costs. This type of specialization has taken place most clearly in the poultry, pig and dairy industries. However, similar consolidation exists among sheep (the use of Suffolk and Rambouillet breeds) and beef cattle (Angus).

Source: CR United States of America (2003).

Box 34
Sheep breeding in Australia

In Australia, conventional non-quantitative techniques for sheep selection have been practised widely in the sheep industry since its inception. They include visual and tactile appraisal by professional sheep classers and "biological" selection approaches such as "Elite" and "Soft Rolling Skin". Systematic cross-breeding, based on recognizable breed populations, is normal in the meat sheep industry and includes a range of rotational and terminal cross-breeding strategies. There is extensive performance recording and selection for those animals that most efficiently meet current market needs for carcasses and wool type. LAMBPLAN is Australia's major system for genetic evaluation in the sheep meat industry. The system is based on estimated breeding values calculated from performance and pedigree information collected from breeders' flocks. In the wool sheep industry implementation of genetic evaluation programmes is not as widespread, reflecting a range of sociological and political characteristics of the industry.

Source: CR Australia (2004).

technology have reduced genetic variation in the commercially viable breeds, and this has led to inbreeding problems. There is, therefore, an increasing interest in cross-breeding to alleviate inbreeding depression, and in ensuring a better match between genotypes and production systems, by using European breeds such as Montbeliarde and Scandinavian Red. Among beef cattle in the United States of America, there is increased use of composite bulls that fit well into structured cross-breeding programmes.

Market pig production in the United States of America has moved from pure-bred systems, to rotational cross-breeding programmes, and now to terminal crossing programmes utilizing specialized maternal and paternal lines or crosses. Compounding the shift away from pure-bred animals has been the rapid adoption of AI in commercial pig production. In Canada, corporate control of pig breeding is increasing and breed populations are used extensively to create selected lines, either pure or composite. Corporate breeding also dominates poultry breeding in Australia, Canada and the United States of America.

6 Conclusions and future priorities

Although livestock owners practise breeding interventions in most production systems, there is considerable variation in the extent of control over this process and the degree to which genetic change takes place in a planned direction. Structured breeding interventions have contributed greatly to the development of livestock production systems and their adaptation to changing conditions. However, standardized

production conditions have also increasingly led to the worldwide spread of a few specialized breeds, especially for poultry, pig and dairy cow production, rather than the development of a broad range of genetic material. In addition to their actual or assumed quality, the spread of the popular breeds and their use worldwide for cross-breeding is favoured by the easy availability and marketing of semen and breeding animals. While some countries, especially in Africa, consider this as threat to their local breeds, many regard it as a means of enriching their livestock population.

The review of the Country Reports reveals large differences between countries and species with respect to planned breeding activities and their support with public funding. It is possible to differentiate the following three broad groups:

- countries that have a tradition of effective breeding programmes for several species and which increasingly transfer these activities to the private sector;
- countries that are in the process of establishing national breeding programmes for one or more species; and
- countries that largely rely on the import of semen and animals for the improvement of their genetic resources.

While the reproductive capacity of pigs and poultry allows the effective implementation of planned breeding programmes under controlled conditions by a small number of breeders or breeding companies within a short period of time, this is more difficult for cattle and small ruminants. In order to achieve a sufficient population size, effective breeding programmes for ruminants have, been based either on larger numbers of individual breeders or on large, often government-owned, nucleus farms. Restructuring in formerly centrally planned economies has reduced the opportunity for breeding based on large government farms. In many developing countries, limited interaction between breeders and ordinary livestock owners, and the priority given to research objectives, have reduced the efficiency and impact of the planned breeding programmes conducted on these farms. The emergence of successful breeding programmes implemented through the involvement of individual breeders in Europe and the Americas was possible because of:

- appropriate organizational structures and the direct involvement of the livestock owners;
- interest in improving the traits under selection and real benefits for breeders and the general population;
- government support and the existence of scientific tools and qualified staff; and
- the existence or development of markets for products (including processing and innovative products) and input supply.

The opportunity which now exists to implement breeding programmes through private organizations is a consequence of the structures that were developed earlier. Breeding is a complex "package" technology. Although it may not be necessary in other countries to repeat the long evolutionary process which led to the development of these breeding programmes, the above-mentioned components are still essential for success. Efforts to establish new breeding programmes have to consider these requirements and should include them. For the breeding of ruminants in particular, there is a need for organized involvement of the livestock owners in close collaboration with cooperative and private breeding organizations. As the genetic variation within livestock species is partly accounted for by differences between breeds and partly by differences among individuals within breeds, selection both between and within breeds has potential to contribute to development.

The full information needed to implement optimum procedures is unlikely to be available at the outset in most medium and low-input systems. This need not be a serious obstacle at the start of a development programme, but it is important to understand the development objectives, and from these to specify the correct breeding goals. Increased research to support breeding activities is required for many production situations, especially in developing countries. Close cooperation with

development efforts is necessary to ensure that the use of the scarce resources available for research is clearly focused on the needs of the breeders, and that results are utilized for action. Moreover, no genetic improvement programme should be established in isolation from a broader attempt to improve other aspects of the production and marketing system.

Livestock enterprises are continuously developing, particularly towards increased scale and greater specialization. These developments will demand different breeds and crosses. Particularly in developed countries, consumer priorities and choices may have an important influence on future breeding goals. Genetic improvement efforts must constantly bear these possibilities in mind and not concentrate solely on breeding objectives focused on today's problems.

The cost of breeding activities, competition, and the international availability of suitable breeding material, are important criteria to be considered when taking decisions regarding support and public funding for national breeding programmes. These decisions are not easy, as a logical and comprehensive approach to the economic evaluation of breeding programmes is still unavailable. Many governments have decided to rely on international genetic material for breed development, especially in poultry and pigs. The information in the Country Reports clearly indicates that countries face problems in the organization and implementation of effective and efficient breeding programmes. This is particularly true for low and medium external input production systems, which are in most cases associated with locally adapted breeds with limited production output. It is unlikely that the private sector will contribute significantly to the cost of new national ruminant breeding programmes in developing countries, in particular for systems with limited potential for increased production. Such costs would have to be borne by national institutions. Cooperation in breeding activities between countries with similar production conditions, such as already happens in Europe and the Caucasus, is an opportunity to share costs and make breeding programmes more sustainable.

References

CR (Country name). year. *Country report on the state of animal genetic resources.* (available in DAD-IS library at http://www.fao.org/dad-is/).

PART **3**

Annex

TABLE 67
List of subsample countries that provided information in predefined tables

Africa	Asia	Europe & the Caucasus
Benin	Bangladesh	Albania
Botswana	Bhutan	Armenia
Burkina Faso	India	Azerbaijan
Burundi	Iran (Islamic Republic of)	Bulgaria
Cameroon	Kyrgyzstan	Croatia
Cape Verde	Malaysia	Cyprus
Chad	Nepal	Czech Republic
Congo	Republic of Korea	Greece
Côte d'Ivoire	Uzbekistan	Iceland
Democratic Republic of the Congo		Latvia
Equatorial Guinea	**Near & Middle East**	Moldova
Ethiopia	Egypt	Norway
Gabon	Iraq	Romania
Gambia	Jordan	Serbia and Montenegro
Ghana		Slovakia
Lesotho	**Latin America & the Caribbean***	Slovenia
Madagascar	Argentina	Sweden
Mali	Brazil	Switzerland
Niger	El Salvador	The former Yugoslav Republic of Macedonia
Nigeria	Guatemala	Turkey
Sao Tome and Principe	Honduras	Ukraine
Senegal	Mexico	
Swaziland	Paraguay	**Southwest Pacific***
Togo	Trinidad and Tobago	Fiji
United Republic of Tanzania	Uruguay	Kiribati
	Venezuela (Bolivarian Republic of)	

*No countries from Latin America and the Southwest Pacific completed the predefined tables that were used in the preparation of tables 63, 64 and 66.

TABLE 68
Strategies and tools used in sheep breeding

	World	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	Southwest Pacific
n	64	24	8	21	7	3	1
Total number of breeds							
Local	419	85	81	186	49	17	1
Exotic	214	31	16	105	53	8	1
Breeds with							
Breeding Goal	33%	14%	33%	52%	5%	16%	0%
Strategy Implemented	31%	9%	33%	50%	5%	8%	0%
Individual Identification	28%	9%	2%	45%	31%	8%	0%
Performance Recording	25%	8%	2%	45%	14%	8%	0%
Artificial Insemination	14%	2%	17%	12%	35%	0%	0%
Genetic Evaluation	19%	5%	18%	21%	37%	0%	0%
Breeds with system of use specified	297	34	33	137	87	4	2
Pure-breeding	57%	65%	91%	64%	29%	75%	100%
Cross-breeding	16%	15%	0%	7%	36%	25%	0%
Both	27%	21%	9%	29%	36%	0%	0%

Regional averages calculated on the basis of information from the subsample countries. n = number of countries providing information.

TABLE 69
Strategies and tools used in goat breeding

	World	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	Southwest Pacific
n	64	24	8	20	8	3	1
Total number of breeds							
Local	219	62	42	57	46	11	1
Exotic	118	34	17	40	21	5	1
Breeds with							
Breeding Goal	19%	21%	12%	28%	12%	13%	0%
Strategy Implemented	16%	15%	12%	25%	12%	13%	0%
Individual Identification	21%	18%	3%	33%	27%	6%	0%
Performance Recording	20%	21%	3%	30%	22%	13%	0%
Artificial Insemination	10%	5%	3%	5%	31%	0%	0%

Regional averages calculated on the basis of information from the subsample countries.
n = number of countries providing information.

• *continues*

TABLE 69 *cont.*
Strategies and tools used in goat breeding

	World	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	Southwest Pacific
Breeds with							
Genetic Evaluation	13%	16%	3%	10%	27%	0%	0%
Breeds with system of use specified	139	46	14	35	38	4	2
Pure-breeding	36%	30%	64%	54%	13%	50%	50%
Cross-breeding	30%	39%	21%	23%	29%	25%	0%
Both	35%	30%	14%	23%	58%	25%	50%

Regional averages calculated on the basis of information from the subsample countries.

TABLE 70
Strategies and tools used in pig breeding

	World	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	Southwest Pacific
n	59	23	7	19	7	1	2
Total number of breeds							
Local	161	39	17	61	40	1	3
Exotic	170	41	14	73	30	0	12
Breeds with							
Breeding Goal	35%	18%	26%	66%	7%	0%	0%
Strategy Implemented	30%	8%	26%	60%	7%	0%	0%
Individual Identification	35%	8%	19%	67%	20%	0%	0%
Performance Recording	34%	9%	19%	68%	10%	0%	0%
Artificial Insemination	28%	0%	19%	49%	29%	0%	0%
Genetic Evaluation	21%	3%	10%	49%	0%	0%	0%
Breeds with system of use specified	245	40	9	121	61	0	14
Pure-breeding	18%	18%	67%	22%	8%		0%
Cross-breeding	34%	65%	33%	21%	36%		43%
Both	49%	18%	0%	58%	56%		57%

Regional averages calculated on the basis of information from the subsample countries.
n = number of countries providing information.

TABLE 71
Strategies and tools used in chicken breeding

	World	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	Southwest Pacific
n	58	24	8	16	6	2	2
Total number of breeds							
Local	360	68	56	139	73	21	3
Exotic	532	146	33	249	83	9	12
Breeds with							
Breeding Goal	13%	2%	20%	22%	0%	13%	0%
Strategy Implemented	11%	1%	17%	20%	0%	0%	0%
Individual Identification	7%	1%	6%	15%	0%	0%	0%
Performance Recording	7%	1%	6%	14%	0%	0%	0%
Artificial Insemination	1%	0%	0%	3%	0%	0%	0%
Genetic Evaluation	6%	2%	6%	10%	0%	7%	0%
Breeds with system of use specified	350	17	21	183	106	13	10
Pure-breeding	51%	24%	76%	39%	67%	85%	50%
Cross-breeding	21%	47%	14%	20%	26%	8%	0%
Both	27%	29%	10%	41%	8%	8%	50%

Regional averages calculated on the basis of information of the subsample countries.

n = number of countries providing information.

TABLE 72
Countries reporting structured breeding activities in minor species

Regions	Horse	Camel	Turkey	Duck	Goose	Rabbit
Africa	1	0	0	0	0	0
Asia	3	2	0	4	0	0
Near & Middle East	1	0	0	0	0	0
Europe & the Caucasus	22	0	3	4	4	4
Caribbean & Central America	1	0	0	0	0	1
South America	2	1	0	0	0	0
North America	0	0	1	0	0	0
Southwest Pacific	1	0	1	0	0	0
World	31	3	5	8	4	5
Percentage (among countries keeping the respective species)	25%	7%	5%	7%	5%	5%

TABLE 73
Stakeholder involvement in structured cattle breeding activities

Regions	Government	Private	Both	Research	Unspecified
Africa	9	0	4	0	0
Asia	5	2	4	2	3
Near & Middle East	1	0	0	0	0
Europe & the Caucasus	3	16	9	1	2
Caribbean & Central America	1	1	0	0	0
South America	0	2	2	1	2
North America	0	2	0	0	0
Southwest Pacific	0	1	0	0	0
World	19	24	19	4	7
Percentage (among countries reporting structured activities)	26%	33%	26%	6%	10%

TABLE 74
Stakeholder involvement in structured sheep breeding activities

Regions	Government	Private	Both	Research	Unspecified
Africa	3	0	1	0	0
Asia	6	0	0	0	1
Near & Middle East	3	0	0	1	0
Europe & the Caucasus	4	12	5	2	3
Caribbean & Central America	1	0	1	0	0
South America	0	0	0	1	2
North America	0	1	0	1	0
Southwest Pacific	1	1	0	0	0
World	18	14	7	5	6
Percentage (among countries reporting structured activities)	36%	28%	14%	10%	12%

TABLE 75
Stakeholder involvement in structured goat breeding activities

Regions	Government	Private	Both	Research	Unspecified
Africa	2	0	0	1	1
Asia	4	2	0	0	3
Near & Middle East	2	0	0	1	0
Europe & the Caucasus	1	12	5	0	4
Caribbean & Central America	0	0	0	0	1
South America	0	0	0	1	0
North America	0	1	0	1	0
Southwest Pacific	0	0	0	0	0
World	9	15	5	4	9
Percentage (among countries reporting structured activities)	21%	36%	12%	10%	21%

TABLE 76
Stakeholder involvement in structured pig breeding activities

Regions	Government	Private	Both	Research	Unspecified
Africa	1	0	0	0	1
Asia	1	0	1	0	2
Near & Middle East	0	0	0	0	0
Europe & the Caucasus	2	16	4	0	2
Caribbean & Central America	1	0	0	0	0
South America	0	1	0	0	0
North America	0	2	0	0	0
Southwest Pacific	0	2	0	0	0
World	5	21	5	0	5
Percentage (among countries reporting structured activities)	14%	58%	14%	0%	14%