Part 3

The state of capacities in animal genetic resource management

Introduction

This part of the Report analyses countries' capacities in the management of animal genetic resources for food and agriculture (AnGR), based on the information provided in the Country Reports. The analysis highlights regional differences, and identifies specific weaknesses; thus informing the identification of strategic priorities for action. The analytical approach varies from section to section according to the nature and the depth of the information provided in the Country Reports. It is important to recognize that the analysis presented here is based on Country Reports that were received by FAO between 2002 and 2005 (the majority being submitted in 2003 and 2004) and may, therefore not present a full picture of the state of capacity in 2007.

The first section presents an analysis the state of human and institutional capacity for AnGR management. This is followed by sections describing the state of structured breeding programmes, conservation programmes, and the use of reproductive and molecular biotechnologies. The final section covers the regulatory framework affecting AnGR. Legal frameworks at the country level need to be considered in the context of international and regional frameworks. Thus, the analysis of legislation and policy measures at the national level is preceded by an overview of relevant international legal instruments; and a discussion of regional-level legislation (mainly focusing on the European Union). Because of the increasing attention given to patenting in the discussion of policies for AnGR management this issue is introduced separately.

SECTION A: INSTITUTIONS AND STAKEHOLDERS

1 Introduction

The implementation of measures to enhance the conservation and sustainable use of AnGR is highly dependent on the existence of a sound institutional framework. Strong human capacity is also essential. A prerequisite for institutional development and capacity building in the field of AnGR management is, however, recognition of the importance of the issue. A further challenge is posed by the fact that the diverse stakeholders involved in the field have many different backgrounds and motivations, and may have conflicting interests.

Institutional roles and capacities have to be considered in the context of the driving forces that influence their development. In broad terms, the institutions involved in the management of AnGR are shaped by the evolving requirements of the livestock sector and changing policy concerns. In addition to these general trends, a number of specific influences have affected the development of institutional capacity over the last decade. These include the Convention on Biological Diversity (CBD), which provides the main international legal framework for the management of biodiversity. The significance of the World Trade Organization (WTO) agreements was also mentioned in many Country Reports. Furthermore, the State of the World's Animal Genetic Resources for Food and Agriculture (SoW-AnGR) reporting process has affected institutional development at the country level through the preparation of Country Reports and the identification and empowering of National Coordinators (NCs) and National Consultative Committees (NCCs) for AnGR. The preparatory meetings which took place as part of the SoW-AnGR process also provided a forum for discussion among stakeholders at the regional level.

The following chapters summarize the state of capacities, institutions and institutional networks in the field of AnGR. The analysis is primarily based on countries' own assessments of the situation as provided in the Country Reports. A brief description of the methodology used to analyse the Country Reports and the other sources used is first presented. Assessments of various aspects of institutional capacity to manage AnGR are then set out. The section ends with a discussion of the main potentials and constraints identified.

2 Analytical framework

The aim of the analysis was to provide an inventory and assessment of human and institutional capacities for the management of AnGR at the national, subregional, regional and international levels.

At the country level, the following factors were considered:

- Stakeholders' involvement in the preparation of the Country Report, along with their involvement in the field of AnGR, their background/history and their group membership. The following categories were used to classify group membership: governmental organization; farmer/herder association; interest organization (conservation); commerce/private company; research/science; development organization; donors; breeding association; extension service; insemination organization/association; international organization (governmental); international organization (non-governmental).
- Institutional assessment – including the following thematic areas: infrastructure/capacities for the management of AnGR; participation of stakeholders at local level; research capacities; (indigenous) knowledge of AnGR; level of awareness of AnGR management; existing or proposed laws and programmes; and the degree of implementation of development policy for AnGR.

At the subregional, regional and international levels, organizations and networks were identified.

2.1 Stakeholders' involvement and background at country level

For the purposes of the analysis, stakeholder participation in the SoW-AnGR process at the country level was taken as a proxy for the existence of established relationships between stakeholders and the officially appointed national institutions for AnGR management. Besides the information given in the Country Reports (e.g. on NCC membership and composition, and on actors involved in the preparation of the Country Report or in activities related to AnGR), additional information on stakeholders and their backgrounds was obtained from FAO's DAD-IS information system and through additional Web-based research.

2.2 Assessment of institutional capacities at country level

The institutional assessment was entirely based on the information provided in the Country Reports. The Guidelines for the Development of Country Reports suggested that one chapter should provide information on "Country capacity to manage AnGR". This section was intended to include institutional infrastructures and human resources. To facilitate consistent reporting, a number of predefined tables were provided:

- Table 4.6 – detailing the role of stakeholders (national government, regional/local government, breeders' organizations, private companies, research organizations, NGOs) in the implementation of tools for the development of AnGR (setting breeding goals, individual animal identification, recording, artificial insemination (AI), genetic evaluation);
- Table 4.7 – detailing the involvement of the various stakeholders in thematic areas related to the development of AnGR (legislation, breeding/genetic improvement, infrastructure, human resources and producers' organizations);
- Table 4.8 – detailing the preferences of the various stakeholders with respect to different types of AnGR (locally adapted breeds, breeds imported from within the region, imported exotic breeds);
- Table 4.9 – detailing priority needs (knowledge, training, financial resources, breeding organizations) for the use of technologies (recording, genetic evaluation, AI/embryo transfer (ET), molecular techniques).

Where available, the information provided in these tables was used for the analysis presented here. However, only 38 percent of countries utilized the tables. For this reason, an analytical framework which also drew on other sections of the Country Reports was developed. The variation in the level of detail presented in the reports was high, and placed some limitation on the scope for quantitative analysis. The sections of the Country Reports that were used as sources of information for each thematic area assessed are shown in Table 53.

Table 53
Sources of information (Country Report sections) for the national level assessments

Thematic area	Part VI: How the Country Report was prepared	Part I: Overview	Part II : Changing demands, policies, strategies, programmes	Part III: State of national capacities, assessing future capacity building requirements	Part IV: Identifying national priorities	Part V: International cooperation	Annex: Predefined tables prepared for stakeholder involvement, priorities, etc.
Infrastructure/ capacities	●	●	●	●		●	●
Participation of stakeholders at local/regional level	●	●		●			●
Research	●			●		●	
Knowledge	●			●		●	
Awareness for topic	●	●	●	●	●		
Laws, political programmes		●	●		●	●	●
Degree of implementation			●		●	●	●

(See the Annex to this section for explanation)

For each thematic area in the institutional assessment, a score was awarded according to the level of activity/capacity in the country in question. Countries were scored 0 (nothing), + (little), ++ (medium) or +++ (high). Scores for each thematic area were assigned subjectively taking into account criteria such as Country Report descriptions of the state of capacity, tabulated information (if available), and reported priority needs (see details in the Notes to Annex Table 53). The proportion of countries scoring at 0, +, and ++/+++ in the institutional assessments is presented for each subregion.

The individual country scores in each thematic area of the institutional assessment were aggregated to characterize the subregional/regional situation. The maximum score (achieved if all the countries in a subregion or region scored "+++" for the category in question) is equal 1 (or 100 percent) and the minimum score (if all the countries in a subregion or region scored "0" for the category in question) is equal 0. The average scores the regions achieved in the institutional assessments are shown in Figure 43 (the scores for the subregions are shown in the tables in the Annex to this section). The different thematic areas were arranged on a scale ranging from basic/organizational capacities to strategic capacities for AnGR management. For example, low scores in the assessment of infrastructure indicate a need for action at a basic/organizational level, while a high score for implementation of laws and political programmes indicates existing activities at a strategic level. This aggregation allows the identification of specific weaknesses of subregions/regions with respect to their institutional capacities. Comparison with the country assessments allows the identification of countries with the potential to play a leading role in the subregions.

2.3 Organizations and networks with a potential role in regional and international collaboration

In most Country Reports, some information on cooperation was presented. Additional Web-based research was used to obtain further information on stakeholders and their backgrounds at subregional, regional and international levels. Further sources of information used for the analysis of institutional structures, and the identification of stakeholders and networks at these levels, were reports from international (governmental and non-governmental) organizations received as part of the SoW-AnGR process, and information from the regional/subregional e-mail consultations organized by FAO in late 2005.

3 Stakeholders, institutions, capacities and structures

3.1 Stakeholder involvement in the State of the World process at country level

The results presented in this subchapter are intended to indicate the extent to which established relationships exist between the officially appointed country-level institutions for AnGR management and the various stakeholders involved in the field. Stakeholder participation in the SoW-AnGR process is used as a proxy measure of such involvement. For the preparation of the Country Reports, countries were encouraged to involve all stakeholders – governmental and non-governmental (e.g. breeders' associations), as well as the commercial sector. In addition to the nomination of an NC, the establishment of a supporting structure, such as a National Consultative Committee (NCC) representing all stakeholders was recommended, and was implemented in most countries.

The pattern of participation by various stakeholder groups in the process varied little from country to country. Individuals from governmental and scientific backgrounds were the most often involved. Institutions of the National Agricultural Research Systems (NARS) played a leading role in the process, and were actively involved in nearly all NCCs and Country Report preparation processes. In 44 percent of countries, the host institution of the NC was a national research institute. However, many Country Reports note with regret that these institutes are rarely involved in AnGR-related studies, and interest in this topic is often limited to isolated departments which lack adequate financial resources. Moreover, where research institutions do pay more attention to AnGR, the work is usually rather narrow in focus, concentrating on high-output breeds or advanced technical matters.

In 37 percent of countries NGOs (mostly breeders' associations) participated in the NCC. The involvement of NGOs was more prominent in South America and western Europe. This is in accordance with the high number of such organizations existing in these parts of the world. In other regions and countries, conditions for the involvement of these stakeholders were less favourable. In some cases, individual farmers or herders were members of the NCC, but information on their organizational backgrounds is not available.

The commercial sector was rarely included. It is noted in the Country Reports that commercial operators are highly active in the use of AnGR, and are often well organized even at the international level – most notably in the poultry and pig sectors. However, many Country Reports from all regions indicate that the involvement of these stakeholders in national programmes for the conservation of AnGR is difficult, as their interest is limited to breeding programmes relevant to the breeds used in commercial production. Central Asia and the eastern part of the Europe and the Caucasus region were exceptions to this pattern. Here, stakeholders from the commercial sector were more often involved in the NCCs. This may be because of the transitional state of many countries in this part of the world – recent privatization means that stronger links remain between governmental and quasi-commercial stakeholders.

3.2 Assessment of institutional capacities at country and regional level

Participation, infrastructure and capacities

As the utilization and *in situ* conservation of AnGR usually takes place at the local level, considerable participation by non-governmental stakeholders, such as breeding organizations or the private sector in general, in policy processes relating to AnGR might be expected. However, this is not borne out by the majority of the Country Reports analysed. Such organizations have the potential to compensate for weak state structures (such as exist, for example, in many countries in Africa and the former Soviet Union), and to take over key roles in activities such as inventory and *in situ* conservation. CR Czech Republic (2003), CR Spain (2004) and CR Germany (2003), for example, refer to the role of so-called "neo-rurales" or "hobby farmers" in AnGR management.

A strong local-level capacity (e.g. clearly defined and well monitored responsibilities for local stakeholders, and the integration of local organizations in the national policy arena) could be identified mostly in western and northern Europe and, to a lesser extent, in Central and South America. Reports from transition countries emphasize a need for stronger integration of the private sector in order to take advantage of the above-mentioned potential to compensate for the weakness of the state sector in the fields of inventory and monitoring. However, in many regions and subregions an established infrastructure exists in the shape of governmental structures such as extension services, which extend down to the local level. This infrastructure and capacity may offer opportunities for better inventory and monitoring, and for further integration and support of AnGR-related activities at the local level. Some Country Reports remark that infrastructure at a high technical level exists, but is not used because of a shortage of human resources/capacities, financial difficulties or political crises – see for example the Country Reports from the countries of the former Soviet Union, southeastern Europe, and CR Cuba (2003).

Table 54 shows the state of country-level infrastructure and participation based on the Country Report analysis. Particularly in the North and West Africa subregion, in the Southwest Pacific, and in Central Asia, the Country Reports indicate that the present state of infrastructure and capacities is very low or non-existent (+ or 0). For example, 33 percent of countries in Central Asia scored 0 for the state of infrastructure and capacities. However, countries with more favourable conditions (++/+++), such as Australia in the Southwest Pacific, can be identified. These countries have the potential to take on a facilitating role in their respective regions.

Table 54
Institutional assessment – infrastructure and capacities and participation

Region		Infrastructure/Capacities [% of countries]			Participation of local/regional level [% of countries]		
	n*	0**	+	++/+++	0	+	++/+++
AFRICA							
North and West Africa	24	29	63	8	71	25	4
East Africa	7	14	57	29	29	71	0
Southern Africa	11	18	64	18	46	36	18
ASIA							
Central Asia	6	33	67	0	83	17	0
East Asia	4	0	50	50	25	25	50
South Asia	7	0	43	57	14	57	29
Southeast Asia	8	13	63	25	38	63	0
SOUTHWEST PACIFIC	11	27	64	9	73	18	9
EUROPE & THE CAUCASUS	39	10	21	69	13	18	69
LATIN AMERICA & THE CARIBBEAN							
Caribbean	3	0	33	67	0	67	33
Central America	9	11	67	22	44	33	22
South America	10	0	30	70	0	70	30
NORTH AMERICA	2	0	0	100	0	0	100
NEAR AND MIDDLE EAST	7	0	86	14	43	57	0

** n=number of Country Reports included in the analysis; ** 0= nothing, +=little, ++/+++=middle/high*

NGOs' limited integration in the policy arena and in the preparation of the Country Reports can be interpreted as a sign of limited organizational capacity at the country level (NGOs simply do not exist), or as a sign of a lack of mechanisms to involve NGOs in such processes. In nearly all countries (87 percent), no institutional structures apart from the NCC, exist for the comprehensive coordination of activities related to AnGR. The importance of the NCC is emphasized by the countries as well as by the Intergovernmental Technical Working Group on AnGR (ITWG–AnGR) and other stakeholders involved in policy processes. Nonetheless, the operation of the NCCs has not in all cases been sustainable. A survey in 2004 (FAO, 2004) found that 65 percent of NCCs were active at the time. The results of the FAO regional e-mail consultations held in late 2005 (and also the low level of participation in these activities) suggested that this figure had further decreased. In some countries, even the NC is no longer active. This is frequently the result of a lack of resources, which in turn often results from a lack of awareness of the subject.

Research and knowledge

In many countries, capacity is lacking not only in organizational terms, but also at technical and educational levels. Capacity building is prioritized in most Country Reports. In many countries, there are national research institutions for the livestock sector in general, but there is little specialization in the field of AnGR use and conservation. This is reflected by the fact that many of those working in the field were trained in other fields (e.g. as veterinarians) and had to go abroad for further education or specialization in AnGR. University livestock departments rarely offer specialized training in the management of AnGR.

Even where advanced technologies are available, research often remains isolated or remote from local needs and indigenous knowledge. It is also not well linked to the policy level, where further awareness building is required to generate higher levels of support to the field of AnGR management (including

in financial terms). The state and accessibility of knowledge regarding the value and utilization of AnGR is also often described as very weak.

Table 55 shows the state of research and knowledge in the countries analysed. Some countries have the potential to play an initiating or supporting role within a subregion or region (e.g. Japan and China in Asia). To realize these potential benefits, more cooperation among the NARS and other research institutions is necessary. The need for increased cooperation is particularly recognized in Country Reports from Latin American countries (e.g. CR Argentina 2003; CR Colombia, 2003; CR Costa Rica, 2004; CR El Salvador; 2003 and CR Uruguay, 2003) and many express a willingness to engage to a greater extent in coordinated activities.

Table 55
Institutional assessment – research and knowledge

Region / Frequency 0 nothing, + little, ++/+++ middle/high		Research [% of countries]			Knowledge [% of countries]		
	n*	0**	+	++/+++	0	+	++/+++
AFRICA							
North and West Africa	24	46	42	13	42	46	13
East Africa	7	29	43	29	29	57	14
Southern Africa	11	27	73	0	46	55	0
ASIA							
Central Asia	6	17	83	0	33	67	0
East Asia	4	0	25	75	0	25	75
South Asia	7	14	29	57	14	71	14
Southeast Asia	8	25	50	25	50	25	25
SOUTHWEST PACIFIC	11	36	55	9	55	36	9
EUROPE & THE CAUCASUS	39	5	31	64	5	28	67
LATIN AMERICA & THE CARIBBEAN							
Caribbean	3	33	0	67	0	33	67
Central America	9	0	78	22	22	56	22
South America	10	0	30	70	0	50	50
NORTH AMERICA	2	0	0	100	0	0	100
NEAR AND MIDDLE EAST	7	14	71	14	14	71	14

** n=number of Country Reports included in the analysis; ** 0= nothing, +=little, ++/+++=middle/high*

Developing countries in particular express an urgent need for technical assistance. This is most often expressed in the context of the need for an increase in livestock production by means such as the use of imported high-output breeds.

State of policy development: awareness, laws and political programmes and their degree of implementation

Awareness of the value of animal genetic diversity is essential to raising the political profile of the topic, and bringing about appropriate institutional change. In most countries, much remains to be done if these goals are to be achieved. The situation is illustrated in Table 56, which shows that many Country Reports describe the degree of awareness as very low. This is mirrored by the state of policies and programmes, and by their degree of implementation. Although awareness is growing among some stakeholders, this has rarely filtered through to the policy level, as can be seen from the very low numbers of policies that have been implemented to date. Most laws that have been implemented are in the field of animal health, and only a few are related to breeding programmes or policies for the conservation of AnGR.

Table 56
Institutional assessment – state of policy development

Region / Frequency 0 nothing, + little, ++/+++ middle/high		Awareness for topic [% of countries]			Laws, political programmes [% of countries]			Degree of imple-mentation [% of countries]		
	n*	0**	+	++/+++	0	+	++/ +++	0	+	++/+++
AFRICA										
North and West Africa	24	33	54	13	71	25	4	83	13	4
East Africa	7	14	57	29	71	14	14	100	0	0
Southern Africa	11	36	55	9	55	36	9	55	46	0
ASIA										
Central Asia	6	33	67	0	50	50	0	83	17	0
East Asia	4	0	50	50	0	50	50	25	25	50
South Asia	7	14	29	57	14	57	29	43	43	14
Southeast Asia	8	50	25	25	50	25	25	50	25	25
SOUTHWEST PACIFIC	11	73	18	9	55	36	9	73	18	9
EUROPE & THE CAUCASUS	39	8	23	69	10	26	64	13	33	54
LATIN AMERICA & THE CARIBBEAN										
Caribbean	3	0	33	67	33	33	33	67	0	33
Central America	9	22	56	22	33	44	22	67	11	22
South America	10	0	50	50	10	50	40	30	20	50
NORTH AMERICA	2	0	0	100	0	50	50	0	0	100
NEAR AND MIDDLE EAST	7	14	71	14	14	86	0	29	71	0

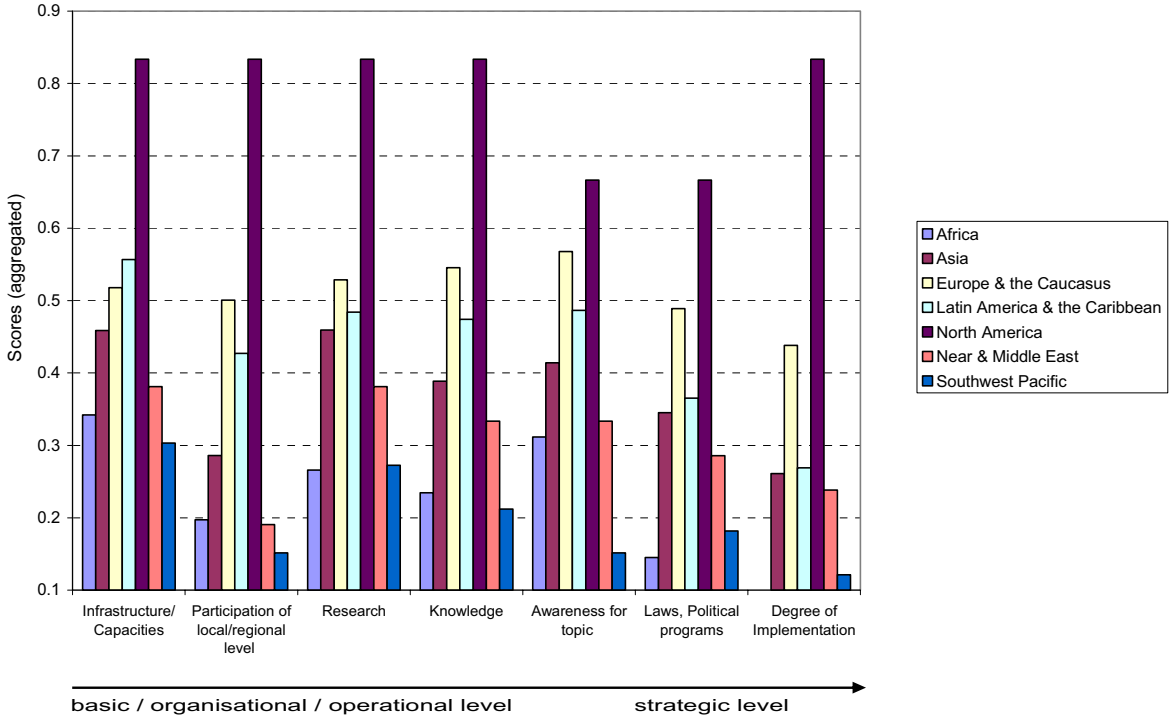
** n = number of Country Reports included in the analysis; ** 0 = nothing, + = little, ++/+++ = middle/high*

As, in many regions, institutional and organizational structures remain poorly developed, further awareness building at national and regional levels will depend on the personal engagement and networking of individuals or isolated departments. Furthermore, to create more awareness of the subject at the policy level, a crucial challenge is to highlight the need for an appropriate balance between immediate demands for high-output breeds and the need to conserve genetic diversity. Many Country Reports, as well as the results of the regional e-mail consultations, indicate the difficulties that stakeholders face in overcoming their isolation and in communicating arguments in favour of conservation in the policy arena, as these arguments relate to a long-term perspective. The need for international assistance to overcome structural or financial obstacles at national level was often expressed.

Regional aggregation of institutional assessments

Figure 43 presents a regional comparison of the state of institutions related to the management of AnGR. The country scores are aggregated at regional (Figure 43) and subregional levels (Annex Figures 44 to 46) to identify regions and subregions with more or less favourable conditions. The figures also allow the identification of specific thematic areas where further support is needed in each region.

Figure 43
State of institutions – regional comparison



As the figure shows, only in North America, Europe and the Caucasus, and to some extent Latin America and the Caribbean, is there a sound base for strategic action. Particularly in North America and western Europe, much action has already been undertaken with regard to policy formulation and implementation (for more details of European Union (EU) legislation see Section E: 3.2). In contrast, in Africa, the Near and Middle East, and the Southwest Pacific weaknesses are evident not only at the strategic level, but also at the basic, operational and organizational levels. Awareness of the value of AnGR and biological diversity in general is expressed strongly in many reports from Latin America and the Caribbean, which also stress the regional character of these resources. However much remains to be done in these countries, as illustrated by the scores of 0.38 and 0.27 achieved by the region for the state of laws and programmes, and the state of their implementation, respectively.

Some differences within regions should also be noted. In Europe and the Caucasus, many countries from the eastern part of the region are relatively weak at the strategic level, and also with respect to the basic, organizational and operational levels. The subregions of Asia are also quite heterogeneous, with East Asia achieving higher scores in all thematic areas than the other Asian subregions. Country Reports from the East Africa subregion indicate that awareness of the topic is growing – which should provide a base for future action at the strategic level.

Comparing the status of individual countries (Annex Table 58) with the averages for the regions and subregions may help to identify countries with potential to play a facilitating role at regional or subregional level. Such suggestions on the basis of Country Reports written over a period of several years (the first being received by FAO in 2002) have to be considered with care, as circumstances may have changed and new opportunities or new constraints may have arisen. Nevertheless, it is evident that some countries are in a favourable position to play a facilitating role. For example, Australia offered, during the e-mail consultation, to support the implementation of regional cooperation networks. South Africa has offered laboratory capacity for the Southern Africa subregion, as has Malawi. Similarly, there may be potential for North African countries to assist with AnGR-related research in West African countries. Japan has played a leading role – financing a cooperative project in the subregions of Asia.

3.3 Organizations and networks with a potential role in subregional, regional and international collaboration

Subregional and regional organizations and networks

This subchapter gives an overview of networks/organizations at subregional and regional levels mentioned in the Country Reports and during the regional e-mail consultations (Table 57). The current state of networks for the management of AnGR is varied across the regions and subregions. In Europe and the Caucasus, networks at governmental and non-governmental level exist, but in other regions the situation is less favourable. In Central Asia, no networks are mentioned. This is explained in the Country Reports from this subregion by the breakdown of structures following the collapse of the Soviet Union (see for example CR Kyrgyzstan, 2003). Networks with a focus on AnGR exist in and between East and Southern Africa. However, no concrete networks are mentioned for North and West Africa, which is a heterogeneous subregion with a long history of conflicts. In South and Central America, there is a basic network structure which also involves Spain. The two North American countries report cooperation with Latin America and the Caribbean, but no specific networks are mentioned.

The basis of many networks is research – one element of which is research related to AnGR. This is reflected in the few concrete proposals for further international networking given in the Country Reports. Where such proposals are put forward, (e.g. CR Argentina, 2003; CR Uruguay, 2003; and CR Japan, 2003), they mainly relate to the establishment of subregional "centres of expertise" covering fields such as research or training on specific breeds or methodologies.

Networks that are exclusively built for AnGR management are rare. Moreover, there are only a limited number of networks and organizations that focus on the subject or that have related activities and programmes. Examples include the European Association for Animal Production (EAAP), the SAVE Foundation (Safeguard for Agricultural Varieties in Europe), the Inter-Governmental Authority on Development (IGAD), the Southern African Development Community (SADC) and the Southern African Centre for Cooperation in Agriculture and Natural Resources Research and Training (SACCAR). However, some other networks are mentioned in the Country Reports as being relevant to livestock development. Most frequently these are economic networks[1]. Such organizations provide a platform for networking in the field of AnGR. It should be noted that there is a growing awareness of the value of AnGR arising from the globalization process, international trade in animals and animal products, and the world trade agreements (see for, example, CR Cuba, 2003; CR India 2004; CR Malaysia, 2003; CR Switzerland, 2002; CR Tonga, 2005 and CR Zambia, 2003). These developments, as the Country Reports indicate, have increased motivation to build networks related to animal production, but have not yet led to concrete action specifically for AnGR.

Another point to be stressed is the varying degree of activity of the few networks that do exist. The Country Reports do not give much indication of the actual role which the different organizations/networks play in AnGR management or of their concrete activities. Furthermore, other networks exist that are not mentioned in the Country Reports[2]. Thus, the available information only provides a starting point for identifying organizations and networks that have potential for coordinating future actions.

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[1] For example: the Southern Common Market (MERCOSUR) in Latin America; the Economic and Monetary Community of Central Africa (CEMAC) in Africa; the Caribbean Community and Common Market (CARICOM) in the Caribbean; D-8 as a body for development cooperation among Bangladesh, Egypt, Indonesia, the Islamic Republic of Iran, Malaysia, Nigeria, Pakistan and Turkey; and the Asia-Pacific Economic Cooperation (APEC) with its Agricultural Technical Cooperation Working Group (ATCWG).

[2] For example in Africa the two agricultural research and development networks: FARA (Forum for Agricultural Research in Africa) and CORAF/WECARD (Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricole/ West and Central African Council for Agricultural Research and Development), were not mentioned by any African Country Report. Another example of an institution not mentioned in the Country Reports is the Centre International de Hautes Etudes Agronomiques Méditerranéennes (CIHEAM), which conducted an advanced training course on conservation and management of AnGR in 2003.

Table 57
Organizations and networks that play or may play a role in animal genetic resources management at regional/subregional level

	Networks/Organizations	
Region	Name	Description
AFRICA	ILRI (International Livestock Research Institute)	Research and training, CGIAR centre
North and West Africa	IRD (Institut de Recherche pour le Développement, ex-OSTROM)	Research projects and scientific programmes on relations between humans and environment in the tropics
	CIRDES (Centre International de Recherche-Développement sur l'Elevage en Zone Subhumide)	Regional research centre, focusing on epidemiological research and the application of new biotechnologies
	CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement)	French research institute for agricultural research in the service of developing countries and French overseas departments
	ICARDA (International Center for Agricultural Research in the Dry Areas)	Research and training, CGIAR centre
	ACSAD (The Arab Center for Studies of Arid Zones and Dry Lands)	Centre for agricultural research and development, within the frame of the League of Arab States
East Africa	ASARECA (The Association for Strengthening Agricultural Research in Eastern and Central Africa)	Agricultural research network
	IGAD (Intergovernmental Authority on Development)	Regional cooperation for overall development, was created as the Intergovernmental Authority on Drought and Development (IGADD)
Southern Africa	SADC (Southern African Development Community)	Development community, was a party to a UNDP/FAO project on AnGR management
	SACCAR (Southern African Center for Cooperation in Agricultural and Natural Resources Research and Training)	Agricultural research and training network, active at the policy level
ASIA		
Central Asia		
East Asia		
South Asia	SAARC (South Asian Association for Regional Cooperation)	Subregional cooperation platform to enhance economic growth, social progress and cultural development
Southeast Asia	ASEAN(Association of Southeast Asian Nations)	Subregional cooperation platform to enhance economic growth, social progress and cultural development
	ARCBC (ASEAN Regional Center for Biodiversity Conservation)	Centre for exchange of knowledge, an intergovernmental organization of ASEAN
	ILRI	Research and training, CGIAR centre
EUROPE & THE CAUCASUS	EAAP (European Association for Animal Production)	Organization for animal production
	DAGENE (Danubian Alliance for Gene Conservation in Animal Species)	NGO active in AnGR conservation
	Nordic Genebank	Genebank
	SAVE (Safeguard for	Umbrella organization for NGOs working on

	Networks/Organizations	
Region	Name	Description
	Agricultural Varieties in Europe)	conservation of biodiversity in agriculture
LATIN AMERICA & THE CARIBBEAN	IICA (Inter-American Institute for Cooperation on Agriculture)	Regional cooperation for rural development
	ILRI, CIAT (International Center for Tropical Agriculture)	Research and training, CGIAR centres
	ALPA (Latin-American Association for Animal Production)	Professional organization
	FIRC (International Federation of Creole Breeds) or IberoAmerican Federation of Autochthonous and Creole Breeds	Ibero-American Federation of Criollo Breeds
	CYTED (Red XII-H: Ibero-American Network)	Network for AnGR, research and training
Caribbean	CARDI (Caribbean Agricultural Research and Development Institute)	Subregional agricultural research and development institute
South America		
Central America		
NEAR AND MIDDLE EAST	ACSAD (Arab Center for Studies of the Arid Zones and Dry Lands)	Centre for agricultural research and development, within the frame of the League of Arab States
	AOAD (Arab Organization for Agricultural Development)	Development, research, training and reporting in food and agriculture in Arab states
	ICARDA	Research and training, CGIAR centre
SOUTHWEST PACIFIC	SPC (Secretariat of the Pacific Community)	Regional cooperation for development
ASIA/NORTH AMERICA/ SOUTHWEST PACIFIC	ATCWG (Agriculture Technical Cooperation Working Group) Part of APEC (Asia-Pacific Economic Cooperation)	Forum for exchange of information between technical and scientific experts, e.g. on biotechnology, conservation of genetic resources, pest management and sustainable agriculture

Source: Country Reports and e-mail consultations

Cooperation should be a logical consequence of shared resources. The Country Reports often mention regional cooperation as a necessity and express a willingness to participate. However, there are few examples of concrete activities. A variety of historical factors probably contribute to the lack of cooperation in certain subregions. The Country Reports from some southeast European countries provide examples of the problems faced. International organizations and networks can play a facilitating or mediating role in cases where bilateral or regional cooperation is hindered by such factors.

Nearly all regions lack key stakeholders with the capacity to host a Regional Focal Point (RFP) for AnGR management. Currently, only the European Regional Focal Point is functioning. The former RFP in the Asia region is no longer active. A few potential host organizations are mentioned in the Country Reports or were mentioned during the regional e-mail consultations. For example, in the East Africa subregion, ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa) and IGAD (Inter-Governmental Authority on Development) are mentioned, while SADC (Southern African Development Community) and SACCAR (Southern African Centre for Cooperation in Agriculture and Natural Resources Research and Training) are mentioned in the Southern Africa subregion.

International organizations and networks

Besides FAO's global network of NCs and other stakeholders (along with the discussion forum DAD-Net[3]), no international networks specialized in AnGR management exist. However, some organizations dealing with livestock development have incorporated some aspects of AnGR management into their agendas. The World Association of Animal Production (WAAP) and its various member organizations is an example of an existing international network, although it has not yet achieved worldwide coverage. Organizations covering specific aspects of AnGR management (e.g. animal recording), such as the International Committee for Animal Recording (ICAR) or the International Bull Evaluation Service (INTERBULL) are also named as global players in the Country Reports. NGOs such as Rare Breeds International (RBI) and the League for Pastoral People (LPP) can play an important role in awareness building at local, national and international levels. However, their impact (including that of their training activities) is limited as a result of a lack of financial and human resources. As part of the SoW-AnGR process, intergovernmental and non-governmental organizations were asked to indicate their involvement in the field of AnGR. However, response to the invitation was limited. Reports were received from four international non-governmental organizations, three intergovernmental organizations, and two research organizations. A further three organizations stated that, as yet, they were not undertaking any activities related to AnGR. A summary table showing the responses received from these organizations is included in the Annex to this section (Table 61), and the reports are available in the Annex to the SoW-AnGR (attached CD-ROM). This low level of response may indicate that awareness of AnGR is lacking not only in national agendas, but also at the international level.

The institutions of the Consultative Group on International Agricultural Research (CGIAR) play a central role in research and training activities at the international level. The centres with programmes of research on AnGR are the International Livestock Research Institute (ILRI) and the International Center for Agricultural Research in the Dry Areas (ICARDA). The System-wide Genetic Resources Programme (SGRP), based at the International Plant Genetic Resources Institute (IPGRI), links the genetic resources programmes and activities of all the centres of the CGIAR – covering the crop, livestock, forest and aquatic sectors. Surprisingly, the CGIAR centres do not feature prominently in the Country Reports. They are mentioned as strategic players, but a lack of connection to national needs and structures is mentioned by some countries.

In nearly all Country Reports from developing countries or countries in transition, a strong demand for a genebank for *ex situ* conservation is expressed. The CGIAR centres, under the auspices of FAO, maintain the "International Network of *Ex situ* Collections" together with the CGIAR System-wide Information Network for Genetic Resources (SINGER), which has focused to date on plant genetic resources. It is mentioned in the report contributed by the CGIAR to the SoW-AnGR process that "ILRI in collaboration with relevant international and national agencies is developing an active programme aiming to conserve AnGR, with a focus on *in situ* conservation, but also looking into the role of other approaches to conservation, such as *ex situ in vivo* and *in vitro*." Advances in technology, reductions in costs and changing pressures on diversity mean that a reassessment is needed of the role of *in vitro* technology as a means of conserving AnGR.

It can be argued that even though the international research and development institutions are active in the field of AnGR, there is urgent need for further investment. This is underlined by a report prepared for the Science Council of the CGIAR:

> "The needs for future CGIAR activities in FanGR [farm animal genetic resources] identified throughout this report focus more on filling particular urgent needs rather than obtaining a better balance of activities across the broad spectrum of characterisation, conservation and utilisation. Examples, ... include: a substantial commitment and clear role in development of policy and regulatory frameworks for management of farm animal genetic resources; a detailed assessment and possible active role in *in vitro* conservation of farm animal genetic resources; a clear and focused program on sustainable methods of genetic improvement of farm animal genetic resources" (Gibson and Pullin, 2005, p. 37).

[3] DAD-Net@fao.org

Additionally, a strong demand for regional and international information networks and databases is expressed in the Country Reports. FAO's Domestic Animal Diversity Information System (DAD-IS) and ILRI's Domestic Animal Genetic Resource Information System (DAGRIS) are highlighted in nearly half of the Country Reports as useful tools for information management, even though they still need further improvement (cf. Australian contribution in regional e-mail consultation; CR Malaysia, 2003). For a system like DAD-IS, the interactivity of the database[4] is of great importance, as it gives ownership to the data contributors. The significance of such interactive systems, therefore, relates not only to the management of data, but also to the process of motivation and awareness building. Efforts have been made to achieve harmonization between European and FAO-managed global databases (see Box 69). Another existing resource is the Agro Web, an Internet portal with more than 25 participating countries in Europe and the Caucasus. However, at the time of this analysis, not all member countries had updated their pages, and this portal is not mentioned in any Country Report.

4 Conclusions

The analysis, which was primarily based on the countries' own assessments, shows that in most parts of the world the institutional and structural situation at national, regional and international levels is not always supportive for the sustainable use and conservation of AnGR. AnGR are not a priority topic in most national, regional and international policy arenas. The relevance of AnGR to food security and poverty alleviation is not fully recognized, and this is reflected in the low level of awareness of the subject in many countries, and by its limited presence on international agendas and in the work of international organizations.

Opportunities to specialize in conservation or utilization of AnGR have been limited, and the prominence of the topic is only slowly increasing in the curricula of universities and research centres. This is reflected in the backgrounds of many of those working in the field. Adequate infrastructure and technical resources are also needed for effective management of AnGR, but are often lacking or not used. Research seems sporadic and isolated from policy processes.

Legal structures, policies and development programmes with a focus on AnGR are often lacking, as are basic institutions for characterization, inventory and monitoring, and structures for national and international cooperation. Even where networks for cooperation exist, there is frequently a need for further efforts to vitalize them or to establish new structures for cooperation.

The reasons for this situation are manifold. The Country Reports and the results of the regional e-mail consultations indicate that an emphasis on technical education, and the short-term perspective of livestock sector policies focused on the immediate need to increase output, are contributing factors. The benefits accruing from investment in AnGR conservation and utilization are often only to be achieved in the long term, and are associated with a degree of uncertainty. It is, therefore, difficult to communicate the need for investment in AnGR management in the policy arena. The commercial sector, which would often have the financial means to support conservation activities, is difficult to integrate into programmes for the management of AnGR. For example, few countries achieved the inclusion of commercial stakeholders in NCCs or in the preparation of the Country Reports. This does not seem to be a case of conflicting interests, but simply of a lack of shared interests. The objectives of commercial operators tend to be short-term profitability, and their interests centre on the limited range of livestock breeds that can achieve high levels of output in large-scale production units. If greater integration of the commercial sector is to be achieved, there is a need to demonstrate the relevance of publicly sponsored conservation activities in terms of enhancing profitability and providing insurance in the longer term. A potential area of cooperation could be for private-sector AI companies to share "low-value" cryoconserved genetic material that they have in their keeping with national programmes.

[4] DAD-IS:3 is part of a global network of stand alone information systems. The network allows FAO's DAD-IS to be linked to regional databases – such as EFABIS (European Farm Animal Biodiversity Information System), successor to EAAP–AGDB (European Association of Animal Production – Animal Genetic Data Bank) at http://efabis.tzv.fal.de/ – and in turn to national databases in individual countries. The global network enables the automatic propagation of public data to all databases in the network – enhancing communication and the availability of information at all levels. Individual countries have the option to establish their own national Web-based information systems, into which the country's AnGR related information can be entered. Alternatively, countries can make use of the global or regional systems.

In many countries there also seems to be a lack of national NGOs interested and active in AnGR management. Where such organizations exist, for example in India[5], they were often not present in the NCCs or involved in the preparation of Country Reports, and are not involved in reporting on the state of AnGR diversity. Only in Europe, North America, South America and Australia is the involvement of NGOs more prominent. In some countries, national rare breed societies make an important contribution to conservation efforts. However, it is clear that further efforts need to be undertaken, both at the country level and by the international community, to strengthen stakeholder involvement in AnGR management.

Ex situ conservation is cost-intensive, and in most countries cannot be undertaken without international support. The central problem for *in situ* conservation is the heterogeneity of the users of AnGR and the fragile state of the production systems under which many threatened breeds are managed. For example, CR Czech Republic (2003)[6] and CR Bulgaria (2004) report that local breeds considered to be of low productivity are increasingly kept only by older farmers. When the working lives of these farmers end, the keeping of these breeds will also end unless steps are taken to promote their continued use. In countries where cattle are largely kept by herders practising mobile husbandry, changing economic, ecological and political conditions threaten the herders' livelihoods and, thereby, restrict opportunities for the implementation of *in situ* conservation measures. Establishing an institutional environment able to respond to such problems is difficult even at the national level, and presents a greater challenge at international level. These arguments underline the need for international cooperation to overcome structural or financial obstacles at the national level. Consequently, there is an urgent need for functioning national and regional structures to support sustainable use and conservation of AnGR.

Box 23
Suggestions for strengthening national structures

Where possible, National Coordinators (NCs) should be made full-time professionals dedicated to the management of AnGR. They would, thus, be able to allocate sufficient time to the coordination of activities at the country level, and to close cooperation with relevant stakeholders. Adequate financial resources should be provided for the work of the NCs. Experience in some countries indicates that funding is improved when AnGR management is mainstreamed within the hosting institution's annual work plans and agendas. Other key stakeholders, such as breeding companies, research and training organizations, NGOs and representatives of community organizations, are also potential sources of funds. Such opportunities will, of course, differ from country to country.

As well as financial support, NCs need to be supported by well-organized national structures with clearly defined functions and roles. The necessary technical expertise to implement these functions needs be in place. The regional and the global focal points may provide support in this respect, but training to strengthen human resources at the country level is frequently an important priority. Efforts should be made to increase awareness of the importance of AnGR at government level. The inclusion of priority actions for AnGR management within governments' action plans for poverty alleviation and food security is a means to facilitate closer cooperation between NCs and other ministries.

Source: extracted from S. Moyo (2004). Strengthening national structures for the management of farm animal genetic resources – (contributions from a National Coordinator). Working Document written for FAO.

The NCCs, which were established during the preparation process of Country Reports, are a means of supporting the work of the NCs. The committees should be maintained and/or further developed as a mechanism for the involvement of all stakeholders and the organization of coordinated action. The establishment of focal points in the regions and subregions is a further important step in coordinating cross-border activities. Strong regional and subregional networks supported by development partners are important to ensure ongoing improvements in capacities and institutions for AnGR management. However, such networks are still not well developed, and cooperation is hindered not only by a lack of awareness of the subject, but also by a lack of settled relations between some countries.

[5] In India there are several NGOs such as ANTHRA (a trust of women veterinary scientists), LPPS (Lokhit Pashu PalakF Sansthan) and SEVA.
[6] Following the development of the Country Report, the Czech Republic amended its Breeding Act to reflect AnGR issues particularly to implement a monitoring system and reaction mechanism which is based on a subsidy system.

In the field of research and knowledge, the NARS are key players at the country level. The Country Reports note a lack of links between the NARS and the CGIAR centres, which is a further important structural gap. Moreover, AnGR is still not prioritized in the activities of the NARS or the CGIAR, and further awareness building is needed. The same is true for the international donor community. As, particularly in developing countries, the infrastructure (e.g. for inventory and monitoring of AnGR) is weak, a further engagement of the donor community is needed.

The Country Reports and the regional e-mail consultations, however, indicate that the SoW-AnGR preparation process has given rise to developments in the field of AnGR management. Awareness, the key to policy and institutional change, is growing in most countries, and new networks are being created.

5 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/).

FAO. 2004**.** Strengthening national structures for the management of farm animal genetic resources – results of a questionnaire survey. Commission on Genetic Resources for Food and Agriculture, Tenth session, Rome, 8–12 November 2004.

Gibson, J. & Pullin, R. 2005. *Conservation of Livestock and Fish Genetic Resources: joint report of two studies commissioned by the CGIAR Science Council*. Rome. CGIAR Science Council Secretariat. (available at http://www.sciencecouncil.cgiar.org/activities/spps/pubs/AnFiGR%20study%20report.pdf).

6 Annex

Notes to Table 53
List of criteria taken into account to assign scores to each thematic are:

Infrastructure and capacities

- State as described in the Country Reports.
- State as detailed in Table 4.7 of the Country Reports (see Section A: 2 for description of the contents of this table).

Participation of stakeholders at local/regional level

- State as described in the Country Reports.
- Existing mechanisms for participation and integration of stakeholders; participation in the preparation of the Country Reports, in the NCC or other structures (who has which role and what authority), degree of organization, and influence in policy setting.
- Existence of decentralized or centralized structures (as mentioned in the Country Reports).

Research

- State of research as described in the Country Reports (capacities, number of institutions, grade of specialization in AnGR, priorities, research focus in the country).
- Role/relevance of research related to varying aspects of AnGR as described in Tables 4.6 – 4.9 of the Country Reports (see Section A: 2 for description of the contents of these tables).
- Participation of research institutions in the NCC, in report writing, and in other existing national/international structures.

Knowledge

- State and efficiency of AnGR-related extension services as described in the Country Reports.
- State and accessibility of (indigenous) knowledge as described in the Country Reports.
- Priority needs as described in Table 4.9 of the Country Reports (see Section A: 2 for description of the contents of these tables).

Awareness

- State as described in the Country Reports (priorities, policy focus).
- Role of various stakeholders with respect to legislation (Table 4.7 of the Country Reports – see Section A: 2 for details of this table).

Laws and political programmes

- Number and state of laws, programmes as described in the Country Reports (chapter on legal situation, institutions and programmes).

Degree of implementation

- Degree of implementation of laws and programmes as described in the Country Reports (chapter on legal situation, institutions, and programmes).

Figure 44
State of institutions – subregional comparison within Africa

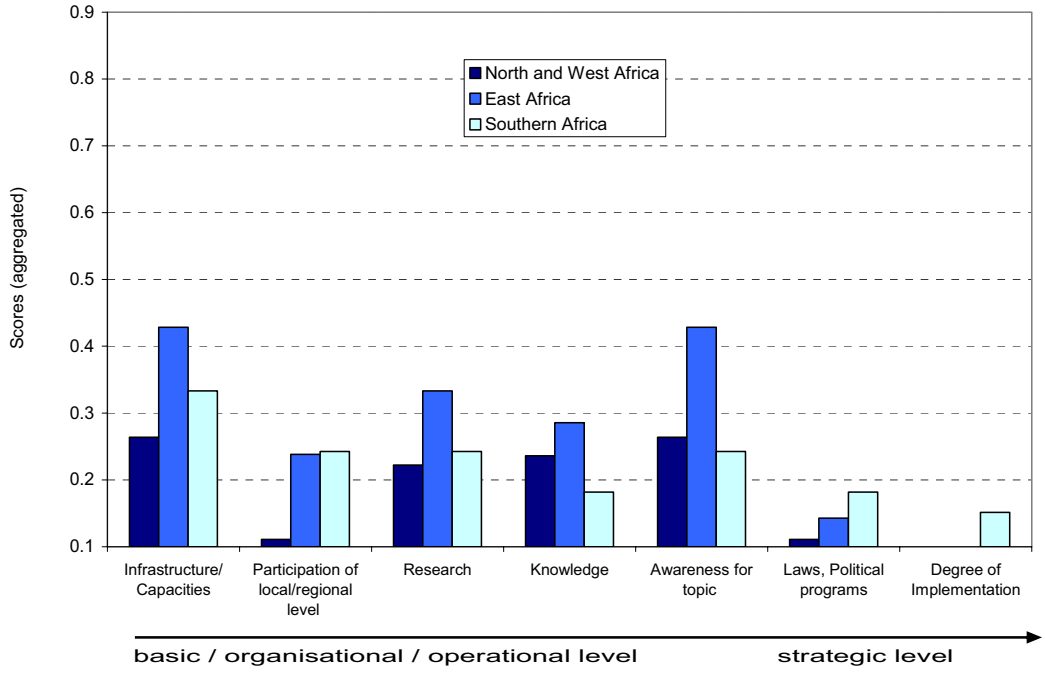


Figure 45
State of institutions – subregional comparison within Asia

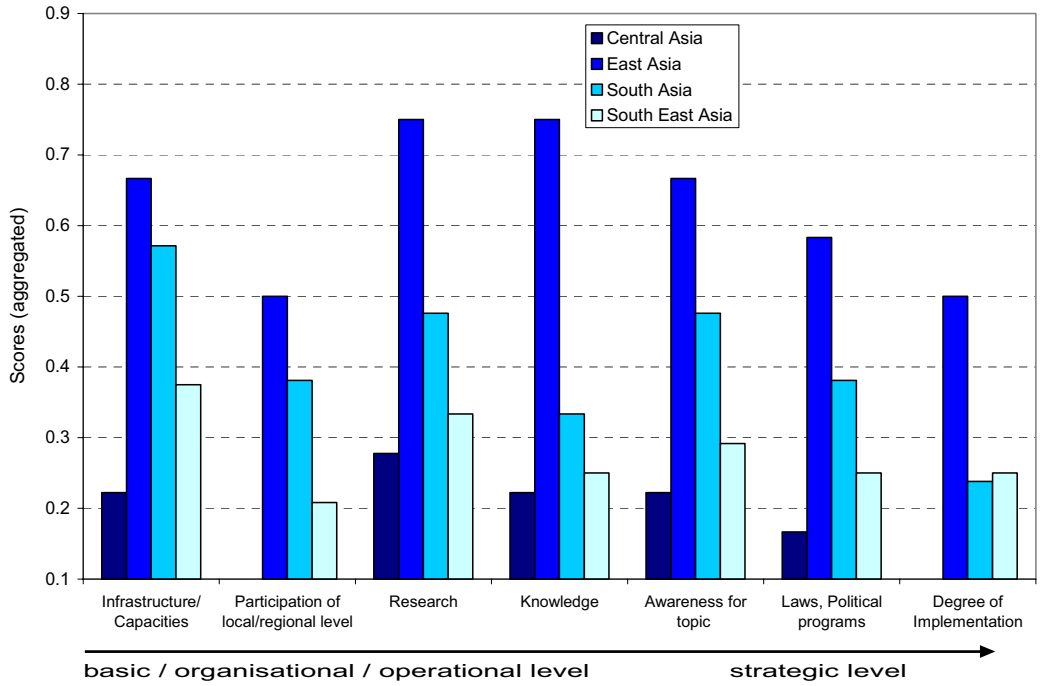


Figure 46
State of institutions – subregional comparisons within Latin America and the Caribbean

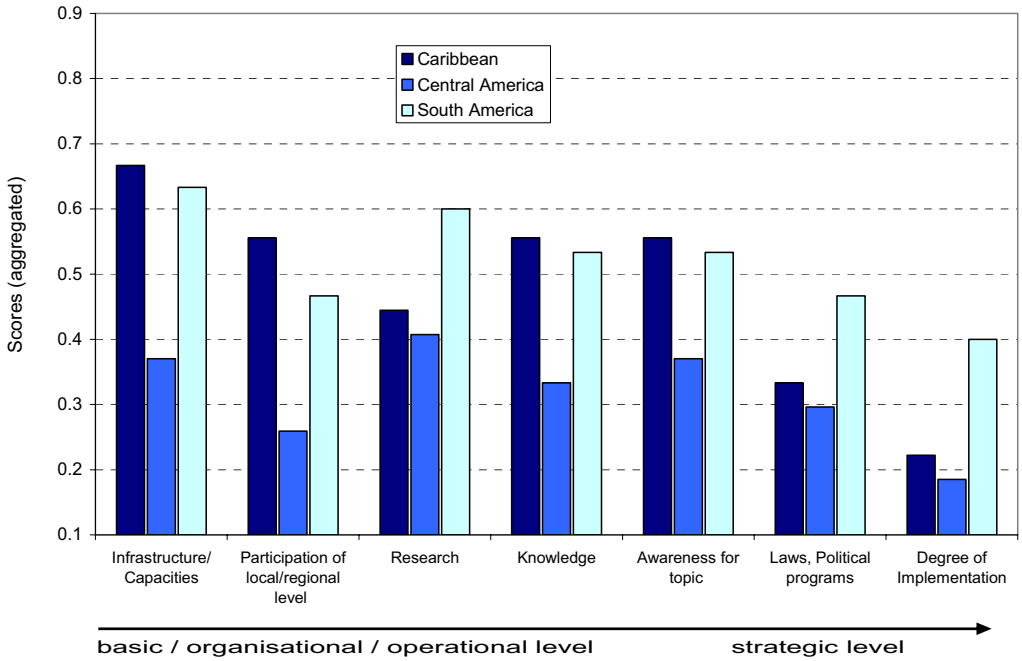


Table 58
Institutional assessment at country level

Subregion/Country	Research	Knowledge	Awareness for topic	Infrastructure / Capacities	Participation of local / regional level	Laws, Political programmes	Degree of Implementation
North and West Africa							
Algeria	+	++	+	+	0	0	0
Benin	0	0	0	+	+	0	0
Burkina Faso	+	+	0	+	0	0	0
Cameroon	+	+	++	+	0	0	+
Cape Verde	0	0	0	0	0	0	0
Central African Republic	0	0	+	+	+	+	0
Chad	0	0	0	0	0	0	0
Congo	+	+	+	+	0	0	0
Côte d'Ivoire	+	+	++	+	+	++	++
Democratic Republic of the Congo	0	0	0	++	0	0	0
Equatorial Guinea	0	0	+	0	0	0	0
Gabon	0	0	0	0	0	0	0
Gambia	0	+	+	+	0	0	0
Ghana	+	+	+	+	++	+	0
Guinea	+	+	+	+	0	0	0
Guinea-Bissau	0	0	0	0	0	0	0
Mali	+	+	+	+	0	+	0
Mauritania	0	0	0	0	0	0	0
Niger	++	++	++	++	+	+	+
Nigeria	++	+	+	+	0	+	+
Sao Tome and Principe	0	0	+	0	0	0	0
Senegal	+	+	+	+	+	+	0
Togo	+	+	+	+	+	0	0
Tunisia	++	++	+	+	0	0	0

Table 58
Institutional assessment at country level (cont.)

Subregion/Country	Research	Knowledge	Awareness for topic	Infrastructure / Capacities	Participation of local/regional level	Laws, Political programmes	Degree of Implementation
East Africa							
Burundi	0*	0*	+	0*	0*	0*	0
Eritrea	0	+	0	+	+	0	0
Ethiopia	+	+	+++	+	+	0	0
Kenya	++	++	+	+++	+	+	0
Rwanda	+	0	+	+	0	0	0
Uganda	+	+	++	+	+	++	0
United Republic of Tanzania	++	+	+	++	+	0	0
Southern Africa							
Angola	+	0	0	+	0	0	0
Comoros	0	0	0	0	0	0	0
Botswana	+	+	++	++	++	+	+
Lesotho	0	0	+	+	++	+	+
Madagascar	+	+	+	+	0	++	+
Malawi	+	+	+	+	+	+	+
Mauritius	+	0	0	+	+	+	+
Mozambique	+	+	+	+	+	0	0
Swaziland	+	+	+	++	+	0	0
Zambia	+	+	+	0	0	0	0
Zimbabwe	0	0	0	+	0	0	0

**The figures presented in this table are based on analysis of the information presented in Country Reports received by FAO between 2002 and 2005. The situation in some countries may have changed subsequent to the submission of the Country Report. After countries were given the opportunity to review the first draft SoW-AnGR in December 2006/January 2007, Burundi indicated that the current situation in the country would be better represented if 0 were replaced by + in these columns.*

Table 58
Institutional assessment at country level (cont.)

Subregion/Country	Research	Knowledge	Awareness for topic	Infrastructure / Capacities	Participation of local / regional level	Laws, Political programmes	Degree of Implementation
Central Asia							
Iran (Islamic Republic of)	+	+	+	0	0	+	0
Kazakhstan	0	0	0	0	0	0	0
Kyrgyzstan	+	+	+	+	0	+	0
Tajikistan	+	+	+	+	+	0	0
Turkmenistan	+	0	+	+	0	0	0
Uzbekistan	+	+	0	+	0	+	+
East Asia							
China	+++	+++	+++	+++	0	+++	+++
Japan	+++	+++	+++	+++	+++	++	++
Mongolia	++	++	+	+	++	+	+
Republic of Korea	+	+	+	+	+	+	0
South Asia							
Bangladesh	++	++	++	+	+	+	+
Bhutan	++	+	++	++	++	++	+
India	++	+	++	+++	+	++	++
Maldives	0	0	0	+	0	0	0
Nepal	+	+	++	+	+	+	0
Pakistan	++	+	+	++	+	+	0
Southeast Asia							
Cambodia	0	0	0	0	0	0	0
Indonesia	+	+	+	+	+	+	+
Lao People's Democratic Republic	+	0	0	+	+	0	0
Malaysia	++	++	++	++	+	++	++
Myanmar	+	0	0	+	0	0	0
Papua New Guinea	0	0	0	+	0	0	0
Philippines	+	+	+	+	+	+	+
Viet Nam	++	++	+++	++	+	++	++

Table 58
Institutional assessment at country level (cont.)

Region/Country	Research	Knowledge	Awareness for topic	Infrastructure / Capacities	Participation of local / regional level	Laws, Political programmes	Degree of Implemen -tation
Europe & the Caucasus							
Albania	+	+	+	+	0	+	+
Armenia	+	+	+	+	+	+	+
Azerbaijan	0	+	++	+	+	+	+
Bulgaria	++	++	++	++	+	++	+
Belgium	+++	+++	+++	+++	+++	++	++
Belarus	+	++	++	++	++	++	++
Bosnia and Herzegovina	0	0	0	+	+	0	0
Croatia	++	++	+*	+*	+*	+*	+
Cyprus	+	+	0	0	0	0	0
Czech Republic	++	++	+++	++	++	++	++
Denmark	++	++	+++	+++	++	++	++
Estonia	++	++	+	++	++	++	+
Finland	+++	+++	+++	+++	+++	+++	++
France	+++	+++	+++	+++	+++	+++	++
Georgia	+	+	0	0	0	0	0
Germany	+++	+++	+++	+++	+++	+++	+++
Greece	++	+	++	++	++	++	++
Hungary	++	++	++	++	++	++	++
Iceland	+	+	++	++	++	++	+
Ireland	++	++	++	++	++	++	++
Latvia	+	+	++	++	++	+	+
Lithuania	++	++	++	++	++	++	+
Moldova	+	0	+	0	0	+	0
Netherlands	+++	+++	+++	++	+++	+++	+++
Norway	+++	+++	+++	+++	+++	+++	+++
Portugal	+++	+++	+++	+++	+++	++	++
Poland	+	++	+	++	++	+	+
Romania	+	+	+	+	++	+	+
Russian Federation	++	++	++	++	++	++	++
Serbia and Montenegro	+	+	+	+	+	+	+
Slovakia	++	++	++	++	++	++	++
Slovenia	+++	+++	+++	+++	++	++	++
Spain	+++	+++	+++	+++	++	+++	+++
Sweden	+++	+++	+++	+++	+++	+++	+++
Switzerland	+++	+++	+++	+++	+++	+++	+++
The former Yugoslav Republic of Macedonia	+	+	+	0	0	0	0
Turkey	++	++	++	++	++	++	++
Ukraine	++	++	++	+	+	+	+
United Kingdom	++	++	++	++	++	++	++

**The figures presented in this table are based on analysis of the information presented in Country Reports received by FAO between 2002 and 2005. The situation in some countries may have changed subsequent to the submission of the Country Report. After countries were given the opportunity to review the first draft SoW-AnGR in December 2006/January 2007,*

Croatia indicated that the current situation in the country would be better represented if + were replaced by ++ in these columns

Table 58
Institutional assessment at country level (cont.)

Subregion/Country	Research	Knowledge	Awareness for topic	Infrastructure / Capacities	Participation of local / regional level	Laws, Political programs	Degree of Implementation
Caribbean							
Barbados	0	+	+	+	+	+	0
Jamaica	++	++	++	+++	+++	++	++
Trinidad and Tobago	++	++	++	++	+	0	0
Central America							
Costa Rica	++	++	++	++	++	+	++
Cuba	+	+	+	+	+	++	+
Dominican Republic	+	+	+	+	0	+	0
El Salvador	+	0	+	+	0	0	0
Guatemala	+	+	+	+	+	+	0
Haiti	+	0	0	0	0	0	0
Honduras	+	+	0	+	0	0	0
Mexico	++	++	+++	++	++	++	++
Nicaragua	+	+	+	+	+	+	0
South America							
Argentina	++	+	+	++	+	+	+
Bolivia	+	+	+	+	+	0	0
Brazil	+++	+++	+++	+++	+++	+++	++
Chile	++	++	++	+++	+	++	++
Peru	++	++	++	++	++	++	++
Colombia	++	++	+	++	+	+	++
Ecuador	+	+	+	+	++	+	0
Paraguay	+	+	+	+	+	+	0
Uruguay	++	++	++	++	+	++	++
Venezuela (Bolivarian Republic of)	++	+	++	++	+	+	+

Table 58
Institutional assessment at country level (cont.)

Region/Country	Research	Knowledge	Awareness for topic	Infrastructure / Capacities	Participation of local / regional level	Laws, Political programs	Degree of Implementation
North America							
Canada	++*	++	++	++*	++	+	++*
United States of America	+++	+++	++	+++	+++	+++	+++
Near & Middle East							
Egypt	+++	++	++	++	+	+	+
Iraq	+	+	+	+	0	+	+
Jordan	+	+	+	+	+	+	+
Lebanon							
Libyan Arab Jamahiriya							
Oman	0	0	0	+	0	0	0
Sudan	+	+	+	+	0	+	0
Syrian Arab Republic	+	+	+	+	+	+	+
Southwest Pacific							
Australia	+++	+++	+++	+++	+++	++	++
Cook Islands	+	+	0	+	0	+	0
Fiji	+	+	0	+	0	+	+
Kiribati	+	0	0	+	0	+	+
Northern Mariana Islands	0	0	0	0	0	0	0
Palau	0	0	0	0	0	0	0
Samoa	+	+	+	+	+	+	0
Solomon	+	+	0	+	+	0	0
Tuvalu	+	0	0	+	0	0	0
Tonga	0	0	+	0	0	0	0
Vanuatu	0	0	0	+	0	0	0

**The figures presented in this table are based on analysis of the information presented in Country Reports received by FAO between 2002 and 2005. The situation in some countries may have changed subsequent to the submission of the Country Report. After countries were given the opportunity to review the first draft SoW-AnGR in December 2006/January 2007, Canada indicated that the current situation in the country would be better represented if ++ were replaced by +++ in these columns.*

Table 59
List of international organizations and contributed reports on their activities

Organizations	Type of response
International Society for Animal Genetics (ISAG)/FAO advisory group on animal genetic diversity	Report on activities, March 2005
Safeguard for Agricultural Varieties in Europe (SAVE) Foundation	Brief Portrait, April 2004
League for Pastoral Peoples	Report on Activities, November 2004
The Mediterranean Agronomic Institute of Zaragoza (IAMZ)	Report on Training activities, January 2005
World Organisation for Animal Health (OIE)	Presentation to the Commission on Genetic Resources for Food and Agriculture, 10th Session, November 2004
European Association for Animal Production (EAAP)	Report of the Working Group on Animal Genetic Resources (EAAP-WG-AGR), February 2005
D8 Countries	Report on Animal Genetic Resources in the D-8 Countries – Strategic Priorities for Action; and Reports on Seminars on Conservation of Farm Animal Genetic Resources
Arab Center for the Studies of Arid zones and Dry lands (ACSAD)	Report on Activities, December 2004
Consultative Group on International Agricultural Research (CGIAR) Centres	Report, Section I: Description of the CGIAR Institutes and Programmes, May 2004
World Intellectual Property Organization (WIPO)	indicated that they had some activities, but did not send a report
International Council for Game and Wildlife Conservation (CIC)	indicated that they had some activities, but did not send a report
Obervatoire du Sahara et du Sahel (Sahara and Sahel Observatory, OSS)	responded that they had no activities in the field of AnGR management
Commonwealth Secretariat, Special Advisory Services Division	responded that they had no activities in the field of AnGR management
Institute for Environment and Sustainability (IES) of the European Commission's Joint Research Centre	responded that they had no activities in the field of AnGR management

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). Note that no countries from Latin America and the Caribbean or the Southwest Pacific are included among the subsample countries. 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.

Table 60
Countries prioritizing breeding activities (by species)

	Cattle	Buffalo	Sheep	Goats	Pigs	Chickens
	[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	Goats	Pigs	Chickens
	[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

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

Table 62
Strategies and tools used in cattle breeding

	World	Africa	Asia	Near & Middle East	Europe & the Caucasus	LAC**	Southwest Pacific
No. of countries	67	24	8	3	21	10	1
Total no. 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 from information of the subsample countries
Latin America and the Caribbean

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 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 10 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.

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.

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**

n: Number of countries reporting and average scores for regions.
Scores (1 = none, 2= little, 3 = regular, 4 = more, 5 = high) indicate the importance given to the activity in current policies.
Highest scores for each region are shown in bold.

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 is 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 70 subsample countries (note that these include no countries from Latin America and the Caribbean, or the Southwest Pacific, as no countries from these regions utilized the relevant pre-defined 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.

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

n: Number of countries reporting and average scores for regions
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 on the implementation of tools that support the development of animal genetic resources. Highest scores for each region are shown in bold.

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 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 the 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.

Table 65
Number of countries reporting the use of artificial insemination

Regions	Cattle	Sheep	Goats	Pigs
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

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

[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.

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 70 subsample countries, indicates that current government policies favour the use of locally adapted breeds for cattle and small ruminants, but exotic breeds for pigs and poultry. This 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).

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
Goats										
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
Pigs										
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

n = number of countries reporting; 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.

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 being 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.

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.

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

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.

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)

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 to be 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 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 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.

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)

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 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 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)

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.

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)

5.3 Europe and the Caucasus

Development of livestock production and breeding activities in western European countries are 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.

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)

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.

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)

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

[8] Norsk Rødt Fe

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.

Box 31
Beef cattle breeding in Brazil

Brazil at present has the largest commercial cattle population in the world. There are approximately sixteen 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)

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 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 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.

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)

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.

7 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/)

8 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	Austria
Burundi	Iran (Islamic Republic of)	Azerbaijan
Cameroon	Kyrgyzstan	Bulgaria
Cape Verde	Malaysia	Croatia
Chad	Nepal	Cyprus
Congo	Republic of Korea	Czech Republic
Côte d'Ivoire	Uzbekistan	Greece
Democratic Republic of the Congo		Iceland
Equatorial Guinea		Latvia
Ethiopia		Moldova
Gabon		Norway
Gambia		Romania
Ghana	Near & Middle East	Serbia and Montenegro
Lesotho	Egypt	Slovakia
Madagascar	Iraq	Slovenia
Mali	Jordan	Sweden
Namibia	Syrian Arab Republic	Switzerland
Niger		The former Yugoslav Republic of Macedonia
Nigeria		Turkey
Sao Tome and Principe		Ukraine
Senegal		
Swaziland		
Togo		
United Republic of Tanzania		

These countries provided the data shown in Tables 63, 64 and 66

Table 68
Strategies and tools used in sheep breeding

	World	Africa	Asia	Europe & the Caucasus	LAC*	Near & Middle East	Southwest Pacific
No. of countries	64	24	8	21	7	3	1
Total no. 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 from information from the subsample countries
**Latin America and the Caribbean*

Table 69
Strategies and tools used in goat breeding

	World	Africa	Asia	Europe & the Caucasus	LAC*	Near & Middle East	Southwest Pacific
No. of countries	64	24	8	20	8	3	1
Total no. 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%
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 from information of the subsample countries
**Latin America and the Caribbean*

Table 70
Strategies and tools used in pig breeding

	World	Africa	Asia	Europe & the Caucasus	LAC*	Near & Middle East	Southwest Pacific
No. of countries	59	23	7	19	7	1	2
Total no. 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 from information of the subsample countries
**Latin America and the Caribbean*

Table 71
Strategies and tools used in chicken breeding

	World	Africa	Asia	Europe & the Caucasus	LAC*	Near & Middle East	Southwest Pacific
No. of countries	58	24	8	16	6	2	2
Total no. 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 from information of the subsample countries
**Latin America and the Caribbean*

Table 72
Countries reporting structured breeding activities in minor animal species

Regions	Horses	Camels	Turkeys	Ducks	Geese	Rabbits
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
% of 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	Not mentioned
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
% of all actors	26%	33%	26%	6%	10%

Table 74
Stakeholder involvement in structured sheep breeding activities

Regions	Government	Private	Both	Research	Not mentioned
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
% of all actors	36%	28%	14%	10%	12%

Table 75
Stakeholder involvement in structured goat breeding activities

Regions	Government	Private	Both	Research	Not mentioned
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
% of all actors	21%	36%	12%	10%	21%

Table 76
Stakeholder involvement in structured pig breeding activities

Regions	Government	Private	Both	Research	Not mentioned
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
% of all actors	14%	58%	14%	0%	14%

SECTION C: CONSERVATION PROGRAMMES

1 Introduction

The SoW-AnGR reporting process has significantly contributed to increasing the awareness of threats to the diversity of AnGR and the need for their conservation. In many countries, it resulted in the approval of national strategies for the management of AnGR conservation programmes, and better coordination of the existing often scattered activities. In countries with weak involvement of the state, it led to the establishment of national bodies for AnGR conservation. The rationale for conservation varies among countries and regions. In some cases, commitment to the principles of the CBD represents the major driving force, while in other cases the prevailing motivation is awareness of the potential importance that breeds currently at risk may have for future production. In some countries, conservation of AnGR is carried out within broader programmes of rural development and environmental management. In the majority of European and in some Asian countries, conservation of AnGR is regarded as an aspect of safeguarding cultural heritage.

The significance of threats to AnGR, particularly of the pressure towards the intensification of livestock production, varies from region to region, as does the current state of genetic diversity, and the economic and social importance of livestock. From a global perspective, a lack of adequate conservation measures is generally of greatest concern when it occurs in situations where the threats of genetic erosion are great and where losses, if they occur, will have large impacts on the diversity of the world's AnGR and on the future socio-economic functions of livestock. Unfortunately, in many such locations, governments lack awareness of the threats and their potential effects.

The prospects for a breed depend to a great extent on its present and future function in livestock systems. As circumstances change, certain breeds are set aside and are faced with the danger of extinction unless action is taken. There are several reasons why the implementation of conservation measures for a particular breed might be considered important: genetic uniqueness; a high degree of endangerment; traits of economic or scientific importance (unique functional traits); and ecological, historical or cultural value (Oldenbroek, 1999). The reason for conservation will, to some extent, determine the effectiveness of the conservation measures. This section discusses conservation from the perspective of ensuring that between and within-breed diversity is maintained for future functional use.

The section[9] draws on the information provided in the 148 Country Reports available by July 2005, in order to describe the state of conservation around the world. The analysis is presented on the basis of seven regions and six species. Where relevant, differences between subregions are presented, and the roles of different stakeholders are discussed.

Only a very few Country Reports provide information on the specific values of breeds included in conservation programmes, or present information on the pedigree of animals under conservation programmes, the number of males and females per generation, or on mating schemes at the species or

[9] Notes on the analysis
The quantification and assessment of conservation programmes is hampered by the following factors, which make it difficult to formulate strong conclusions:
Not all countries use the same definition for local breeds (e.g. all breeds present, breeds originating from the country, or breeds adapted to the local conditions). Thus, the numbers presented for local breeds in conservation programmes have to be treated with caution, and this is the reason why the proportion of local breeds conserved was not calculated.
There is some inconsistency in the Country Reports regarding the definition of *in vivo* conservation programmes. Some countries consider that a breed is being conserved *in vivo* when it is kept by small holders or hobbyists, whereas other countries do not consider this type of activity to be a conservation programme.
Some countries classify the storage of semen stock at an AI centre as an *in vitro* conservation programme, while others consider that an *in vitro* conservation programme exists only if there is a separate genebank facility.
The data are extracted from individual Country Reports written between 2002 and 2005. In this period conservation programmes were under development in many countries. So, for some regions the state of conservation programmes will already have progressed since the analysis was carried out.

breed levels. Thus, the status of conservation is presented here mainly by showing the number of breeds and species indicated by the Country Reports to be included in conservation programmes.

Theoretically, three types of conservation measures can be implemented: *in situ* conservation, *ex situ in vivo* conservation and *ex situ in vitro* conservation (see Box 94 in Part 4 – Section F). In practice, the distinction between *in situ* conservation and *ex situ in vivo* conservation can be rather vague. In the Country Reports, the distinction is often not clear. Therefore, for the purposes of the quantitative analysis presented below, only two types of conservation will be distinguished: *in vivo* (including both *in situ* and *ex situ in vivo*) and *in vitro* (*ex situ*) conservation. Another problem relates to the difficulty of distinguishing *in situ* conservation from "sustainable utilization" (see Part 4 – Section 1 for a discussion of this issue). It is therefore possible that some of the examples of *in situ* conservation mentioned in the Country Reports would in fact be better described as instances of sustainable utilization of the breeds in question.

2 Global status

Fifty-two percent of Country Reports indicate the presence of *in vivo* conservation measures, while only 37 percent indicate the presence of *in vitro* conservation (Table 77).

Table 77
Number of countries with conservation programmes

Region	Subregion	Number of Country Reports analysed	Number of countries with *in vivo* conservation	Number of countries with *in vitro* conservation
Africa	East	7	2	1
	North + West	24	10	4
	Southern	11	6	4
	Subtotal	42	18	9
Asia	Central	6	2	2
	East	4	3	3
	South	7	4	3
	Southeast	8	4	4
	Subtotal	25	13	12
Europe & the Caucasus		39	33	25
Latin America & the Caribbean	Caribbean	3	0	0
	South America	10	5	5
	Central America	9	3	1
	Subtotal	22	8	6
Near & Middle East		7	1	0
North America		2	2	2
Southwest Pacific		11	2	1
	Total	148	77	55

For *in vitro* conservation well-established genebanks are present in Japan, India, the Nordic countries, France, the Netherlands, Poland, the Czech Republic and Hungary. In some countries, the establishment of genebanks is planned: the United States of America, China, the Republic of Korea and Viet Nam. Semen is preserved from all the main species, and embryos of cattle, sheep and goats are also stored. Only a few genebanks store poultry and horse semen. Sometimes tissue DNA samples are also collected in the main species. Genebanks have been initiated by governments or NGOs supported by universities and research centres. In a number of countries the SoW-AnGR reporting process accelerated measures aimed at ensuring coordination among genebanks and the establishment of national databases. In developed countries, there is a strong collaboration between genebanks and the animal breeding industry and breeders' associations with respect to the collection of genetic

material. In developing countries that implement *in vitro* conservation measures, activities are limited to storage of semen from some local cattle and sheep breeds at private or governmental institutions.

3 Stakeholders

The Country Reports indicate that many stakeholders are involved in conservation: national governments, institutes for research and education such as universities, NGOs and breeders' associations, farmers and pastoralists, part-time farmers and hobbyists, and breeding companies. This chapter provides a brief overview of the roles of the various stakeholders.

3.1 National governments

In countries where conservation programmes for AnGR are established, it is national governments that play the crucial initiating role. They provide the legal base for conservation programmes either under legislation relating to the protection of biodiversity or under legislation regulating the management of AnGR, livestock production and breeding. They are partners in the development of national strategies for the management of AnGR, and they also provide funding for implementing institutions, including partial funding of conservation activities carried out by NGOs.

In some African and Asian countries, national governments are involved in breeding activities, often with the aim of increasing national self-sufficiency in food of animal origin. In most cases they own nucleus farms, where local or exotic cattle are kept. These nucleus farms sell breeding stock (males) to improve populations owned by (often small) farmers. The system plays an important role in the conservation of the breeds in question. The farmers keep a large number of animals, and the nucleus farms take care of the genetic diversity of the populations.

Box 35
Mali – role of the government

In Mali, conservation activities have been initiated by the government on research stations and experimental farms. These actions have mainly involved Maure, Peul Soudanais, Peul Toronké and N'dama cattle breeds.

Source: CR Mali (2002)

In a number of European countries, government policies are increasingly focused on conservation and landscape enhancement in rural areas where the economic viability of farming is limited. These policies are supported by state funds and, in case of the EU, by communitary funds (see the discussion of Council Regulation (EC) No. 870/2004 in Section E: 3.2).

Grazing animals, particularly well-adapted breeds of sheep, cattle and horses play an important role in nature management. This role offers an excellent opportunity for the conservation of these species as large numbers of animals are potentially involved. In parts of Europe, governments are also motivated to maintain livestock breeds for socio-economic or cultural/historic reasons. There are many types of governmental institutions, including therapeutic farms, prisons, demonstration farms, farm parks and museums, at which local breeds may be kept. The number of animals conserved in such locations is generally low, leading to risks of inbreeding and random loss of alleles that have a low frequency in the population.

3.2 Universities and research institutes

Farms linked to universities and research institutes are often involved in selling breeding animals or conserving local breeds. They combine these activities with their primary tasks of educating students and carrying out research. Many universities and research institutes try to conserve locally developed breeds, which are no longer used by the industry. They pay a lot of attention to the maintenance of genetic diversity within these populations. However, their role is threatened by cuts in public funding.

3.3 Civil society organizations and breeders' associations

In many developed countries, NGOs conserve and stimulate the keeping of local breeds by (often part-time) farmers and hobbyists. These NGOs and their members play an important role in the conservation of local breeds of chickens, horses, sheep, goats and cattle. One of their objectives is to demonstrate the cultural and historic aspects of breeds for the purpose of education and recreation; another is to produce special products for niche markets. In general, their knowledge of conservation genetics is limited, and the participation of individual breeders in breeding and conservation programmes is often on a voluntary basis. As such, the activities of these organizations do not guarantee the conservation of genetic diversity for future commercial/productive use. However, in many countries (e.g. the Czech Republic) research institutions and universities provide expertise and professional support for conservation activities carried out by breed associations. In addition, national coordinating bodies, governmental inspections, and control of state subventions ensure adherence to national conservation plans.

3.4 Farmers

In Europe and in North America, some farmers target niche markets where they can sell speciality products from local breeds, often kept in natural environments. In these circumstances, the local breeds are often an integral part of the brand – this provides an opportunity for profitable production utilizing breeds that would otherwise be uneconomic. Strict regulation of food production and the associated high levels of investment required can, however, present hurdles to the profitable exploitation of niche markets. In many countries, farmers or farmers' organizations have become involved in organic production. In some cases, traditional breeds are favoured in organic systems because of their good adaptation to the management conditions, and for marketing reasons. Potential opportunities to export organic products are increasingly recognized in many eastern European countries. These developments stimulate interest in a range of traditional or locally adapted breeds, and create a base for breeding and *in vivo* conservation programmes.

In a number of African countries, the continued use of local AnGR within traditional low external input production systems is considered to be the form of conservation that best suits the local conditions, and avoids problems related to the lack of financial resources for other forms of conservation. Uncontrolled mating, changes to traditional production systems and indiscriminate cross-breeding are, however, among the significant risks in this form of conservation.

3.5 Part-time or hobby farmers

The number of part-time farmers and hobbyists keeping farm animals is increasing in the Europe and the Caucasus, North America and Southwest Pacific regions. Most livestock species except the pig are kept for hobby purposes. These hobbyists play an important role in the conservation of local breeds. However, conservation is not their major goal, and their knowledge of the genetic management of populations is rather limited. Conservation programmes performed by hobbyists require special attention from the responsible authorities to make them effective.

3.6 Breeding companies

In Europe, North America and Australia, pork production is highly industrialized and a few transnational breeding companies dominate production chains. These companies develop a few lines from a limited number of breeds which are then used globally. Frozen semen is used for the dissemination of genetic progress, and frozen semen and frozen embryos are used to transfer genetic material on an international scale. In the poultry industry, only three transnational companies are actively selling highly specialized hybrid layers and broilers at the global level. The number of these specialized chickens is increasing very quickly, mainly as the result of intensive marketing by the layer and broiler industries. Specialized dairy and beef breeding is also a transnational activity in which frozen semen and embryos are used to disseminate the genetic progress achieved in the countries and herds of origin. In the pig and poultry sectors, the top-ranking animals in the breeding

populations are owned by the large breeding companies. In genetic improvement programmes for the pure lines, attention is paid to the effective population size in order to avoid inbreeding. The companies do not want to limit their future scope for selective breeding. Genetic diversity within the breeds kept is therefore conserved within these programmes.

4 Conservation at species level – status and opportunities

Table 78 gives the number of breeds per species conserved *in vivo* and *in vitro* at the global level.

Table 78
Conservation activities at the global level

Breeds	Cattle	Sheep	Goats	Pigs	Chicken	Horses
Local	897	995	512	541	1077	570
Regional transboundary	93	134	47	25	55	63
Conserved *in vivo*	324	261	109	120	194	149
Conserved *in vitro*	225	111	44	140	87	33

Regional transboundary breeds are defined as breeds that occur in more than one country but only within one region (see Part 1 – Section B). The countries will probably consider most of these breeds to be local breeds with regard to their origin, as they have a limited regional distribution and have been developed under specific environmental conditions. The number of conserved local breeds stated in the Country Reports, may therefore include regional transboundary breeds. More than one country within a region may conserve the same "local" breed. Thus, the number of distinct breeds conserved may be lower than the number given in the table, which was obtained by summing the number of local breeds conserved in each country. In some countries, even international transboundary breeds (see Part 1 – Section B) might have been counted as locals if they have been in the country for a long time and have adapted to the local conditions. For example, some West African countries consider their Jersey cattle introduced 100 years ago as adapted local breeds.

4.1 Cattle

For high-input systems, specialized breeds of dairy or beef cattle are developed through intense selection, and their genetic material is widely disseminated. Nucleus breeding has started in dairy cattle, but there are still a lot of dairy farmers who participate in breeding activities. On a global level, intense selection for a few production traits, and a large exchange of semen from the best bulls has led to low effective population sizes in the most popular dairy breeds – with a real risk of losing genetic diversity in these breeds. The problem can be avoided by better genetic management at the global level, or by the use of breeding goals with multiple objectives, such as are utilized in some Nordic dairy cattle populations – best illustrated and documented in the Norwegian Red Cattle (Box 83 in Part 4 – Section D).

In the dairy sector, the Holstein-Friesian breed dominates, and in the beef sector, French beef breeds are likely to obtain a similar position in the future. In many countries, these specialized breeds are used for upgrading to improve the performance of local breeds. Only in a few situations are stable cross-breeding systems developed, in which populations of the local breeds are used and conserved. In some countries, dual-purpose cattle breeds are used for organic farming, for emerging functions such as landscape and nature management, or are kept as suckler cows by hobbyists. In all regions, conservation programmes need to be developed for local cattle breeds and for multipurpose breeds that will no longer be used for their original functions (e.g. traction).

In the development and use of specialized breeds, artificial reproduction techniques in combination with cryostorage play an important role. The availability of this technology has created the option of cryoconservation, which has been widely used in the case of semen, and to a lesser extent in the case of embryos and oocytes. Relatively large numbers of cattle breeds are involved in *in vitro* conservation programmes. However, in Africa, Asia, Latin America and the Caribbean, the Near and Middle East and the Southwest Pacific, the development of cattle conservation programmes should be further encouraged, particularly in view of the high adaptation of local breeds to the low to medium external input production systems which prevail in these regions.

4.2 Sheep

In regions and countries with high external input livestock systems, such as Europe and the Caucasus, North America and Australia, the number of sheep has declined in recent years. Sheep wool now has a low economic value, and this is a threat to some breeds. In Europe, nature management is emerging as an important function for this species. This role offers an excellent opportunity for *in vivo* conservation, because of the large flocks required for these purposes.

In small-scale farming systems in Africa, Asia and the Near and Middle East, as well as in eastern parts of the Europe and the Caucasus region, sheep are still important for meat or milk production, and in some religions have a ceremonial function. These roles guarantee continued utilization of the species. Nonetheless, *in vivo* conservation programmes need to be developed in regions such as the Southwest Pacific and Central Asia, where there are major declines in sheep numbers, and in regions or subregions with a high diversity in their sheep populations, such as the Near and Middle East.

AI and freezing techniques for sheep genetic material are well developed, but are not widely used. Semen is stored only in the genebanks of developed countries as a means to protect AnGR against disasters such as major disease epidemics. *In vitro* conservation programmes with similar objectives should be established in developing countries.

4.3 Goats

The goat's importance in small scale farming systems for milk and meat production, and the wide variety of conditions under which it can be kept, guarantee continued utilization. In general, this species is not faced with very significant threats. As such, *in vivo* conservation activities targeting goats do not generally seem to be a particularly high priority. AI is only practised in a limited number of breeds, almost exclusively in developed countries. This is the reason why only a few breeds are preserved by *in vitro* methods. As a precautionary measure, *in vitro* conservation of goat genetic material should be given more attention globally.

4.4 Pigs

As discussed above, in Europe, North America and Australia pork production is dominated by a few transnational companies. As the breeding industry becomes more concentrated, many breeds and lines are taken out of production. In a number of regions including Europe and the Caucasus, Africa and North America, relatively few local pig breeds exist. Conversely, in East Asia there are many local pig breeds. The latter need careful monitoring, and may require additional attention in future conservation programmes because of the threat posed by the increased use of exotic breeds.

The speed of industrialization and specialization, in combination with the lack of opportunities for the *in vivo* conservation of pigs means that this species requires special attention in conservation programmes. Frozen semen is used for the dissemination of genetic progress, and frozen semen and frozen embryos are used for intercompany exchange of genetic material between populations present in different countries. These activities have created a base for *in vitro* conservation in pigs. In Europe and Asia, many of the lines and breeds that are set aside in breeding and cross-breeding programmes, are conserved *in vitro*. However, the status of conservation measures should be monitored in order to identify additional activities that may be required.

4.5 Chickens

In Europe and North America many universities and research institutes try to conserve locally developed (dual-purpose) breeds of chicken that are no longer used by the industry. Many universities have developed experimental lines for a variety of purposes. In many cases, the birds are now scheduled to be culled for budgetary reasons. In eastern Europe, many highly selected lines, bred in the period of the "cold war", are still in existence and should be considered for conservation. In some European countries, some small companies remain involved in the production of layers and broilers, but their number is rapidly declining. In developing countries, the role of chickens in small-scale

farming, and the preference of local people for meat from local birds will promote the continued use of many local breeds. In the developed world, many people keep chickens as a hobby, and this is an opportunity for *in vivo* conservation.

For chickens, *in vitro* conservation of semen is a recent development. Frozen semen from local breeds is stored only in a few Asian and European countries. In this species, *in vitro* conservation of local breeds, recently developed dual-purpose breeds, and lines which are set aside, should get a high priority at the global level. The spread of highly pathogenic avian influenza (HPAI) in 2005/2006 illustrates the risks for a species kept at high densities all over the world.

4.6 Horses

In the past, horses were mainly used for draught and transport. The mechanization of transportation, and later of agriculture, has meant that in many parts of the world horses are now bred almost entirely for leisure purposes and are mainly kept by hobbyists. Many breeds are used in several countries, but international breeding management is rarely reported. The only exceptions are the Icelandic Horse and the Friesian Horse, for which the Icelandic and the Dutch herd books, respectively, coordinate breeding activities and keep control of genetic diversity within the breeds.

The existence of a wide variety of leisure activities involving horses may stimulate the maintenance of genetic diversity within the species. In general, however, the genetic diversity within local horse populations is threatened by the wide use of a few popular stallions. “Heavy” (cold blood) breeds, originally bred for draught purposes, are often threatened; in some countries they are now kept only for meat production.

For horses, *in vitro* conservation of semen is a recent development. In a few countries, frozen semen from local breeds is stored. *In vitro* conservation of local “heavy” breeds should be treated as a priority.

5 *In vivo* and *in vitro* conservation programmes at regional level

5.1 Africa

A large part of the human population of Africa is poorly nourished, and self-sufficiency in food production is a major objective for many governments. Policies aimed at increasing food production, have encouraged local breeders to use exotic germplasm to replace local breeds (chickens), or for cross-breeding/upgrading (cattle and sheep). These activities are not accompanied by adequate breeding and conservation programmes, and threaten many local breeds. The expansion of high external input livestock systems using exotic breeds, along with the threats to local breeds posed by droughts, disease epidemics and political instability reinforce the need to implement *in vivo* and *in vitro* conservation on a wide scale as soon as possible. Achieving this, however, will require a greater awareness of the issue.

Eighteen out of the 42 Country Reports from Africa describe *in vivo* activities. In nearly all these countries the conservation activities are restricted to a few breeds in each species. The number of breeds conserved in goats, pigs, chickens and horses is very low (Table 79).

In comparison to other species, phenotypic and genetic characterization in cattle and sheep is relatively well documented in past and recent literature. For the other species, some phenotypic characterization of local breeds can be found in (historic) handbooks and in recently developed databases. Breeding theory is well developed in various institutes and universities. However, breeding and conservation programmes are difficult to perform, because of a lack of data on population sizes, identification systems and pedigree recording. The knowledge and skills required to implement such programmes are scarce, and the necessary infrastructure is not available. Some countries mention that *in vivo* conservation is performed by pastoralists and small-scale farmers who keep the breeds. However, it is doubtful whether it is really appropriate to describe these activities as conservation programmes.

Table 79
Conservation activities in Africa

	Cattle	Sheep	Goats	Pigs	Chickens	Horses
East Africa						
Local breeds	59	30	35	2	14	4
Conserved *in vivo*	4	1	1	0	0	0
Conserved *in vitro*	0	0	0	0	0	0
North+West Africa						
Local breeds	44	49	29	25	49	24
Conserved *in vivo*	27	10	6	4	0	3
Conserved *in vitro*	5	1	1	0	0	0
Southern Africa						
Local breeds	51	30	22	22	26	8
Conserved *in vivo*	12	7	3	2	1	2
Conserved *in vitro*	6	0	0	0	0	0
Total Africa						
Local breeds	154	109	86	49	89	36
Regional transboundary breeds	35	27	15	2	6	7
Conserved *in vivo*	43	18	10	6	1	3
Conserved *in vitro*	11	1	1	0	0	0

Refer to footnote under Table 78

Most of the programmes described in the Country Reports, include an important role for nucleus herds of local animals kept at governmental or institutional farms. These farms sell breeding material and are used to educate local farmers. None of the Country Reports document a well-established conservation plan.

Box 36
Ethiopia – *in situ* conservation

In Ethiopia, four cattle ranches and one sheep ranch are operating *in situ* conservation measures. The overall objectives of these ranches are the multiplication and cross-breeding of Boran, Horo, Fogera and Arsi cattle, and Menz sheep.

Source: CR Ethiopia (2004)

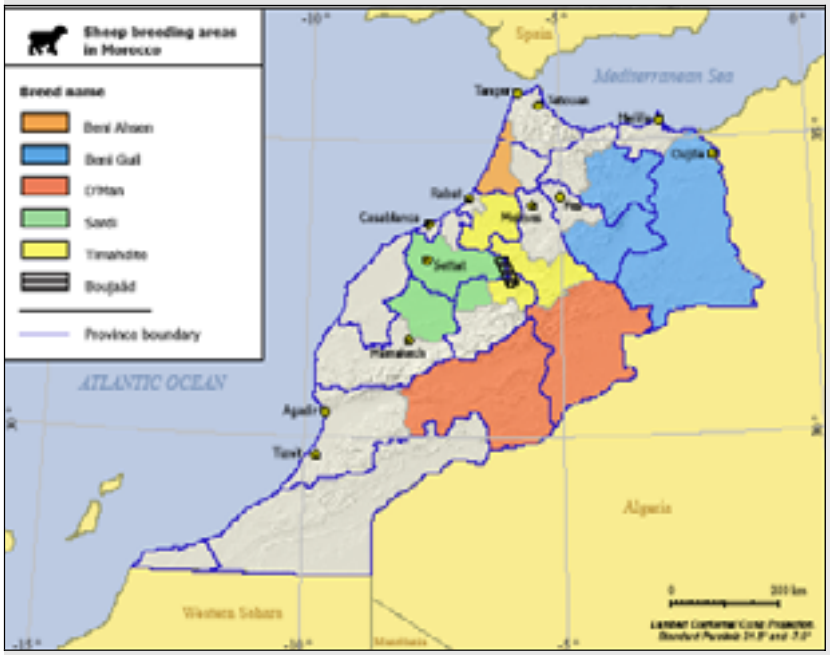
The analysis reveals major differences with respect to conservation activities between the three African subregions. Only 9 of the 42 Country Reports indicate the presence of *in vitro* activities (Table 77). In nearly all these countries the conservation activities are restricted to a few cattle breeds (Table 79). The knowledge necessary to implement such programmes is scarce, and the required infrastructure (e.g. liquid nitrogen facilities) is not available, or cannot be adequately maintained. *In vitro* activities are limited to the storage of semen from some local cattle breeds at private or governmental institutions. Some countries also mention the storage of semen from imported exotic breeds as a strategic activity. Tissue DNA of individuals from local breeds is preserved at a few research stations.

Box 37
Morocco's Plan Moutonnier – designated breeding areas to sustain local sheep breeds

Morocco has made great efforts to establish sustainable management of its sheep genetic resources. An important development was the establishment in 1980 of a programme known as the Plan Moutonnier. The main element of the plan has been the partitioning of the country into zones according to the genetic resources present and nature of the agricultural systems. Each zone has its own set of rules regarding sheep breeding. In the "breeding zones" (zones berceaux de race) only the breed that has existed in the local area for many years is allowed to be kept. In the "cross-breeding zones" (zones de croisement) cross-breeding is permitted without restriction on the choice of breeds. Elsewhere, in the "traditional sheep breeding zones" (zones d'élevage traditionel), several varieties of sheep are permitted with no specific breed predominating.

The breeding zones are established in well-delineated geographical areas where a homogenous type of animal has been raised for a long period of time. The zones cover about 54 percent of the country's territory (see map). The breeds for which breeding zones have been established include the main local breeds – Timahdite, Sardi, Béni Guil, D'man, Béni Ahsen and Boujaâd. Some mountain breeds (Atlas Mountain or Berber breeds) are also included, but the programme is mainly focused on the aforementioned six breeds.

Distribution of breeding zones for local sheep breeds



Source: adapted from Boujenane (2005)

Note that D'Man are only present in the oases and valleys of the depicted zone, and that the delimitations of areas for Boujaâd have been estimated.

The plan has also included selection programmes for the improvement of local breeds in their home areas; the organization of farmers' associations; and encouragement for farmers to improve their local breeds. The plan has met with success thanks to the dynamic role of the sheep keepers' organizations and the support of the state. Largely as a result of the plan and the geographical restrictions on cross-breeding, the impact of exotic breeds on the indigenous sheep population has been limited. Indigenous breeds accounted for 53 percent of the total population in 1996/97 (the most recent census in Morocco categorizing sheep by breed). Since 1970, the Sardi population has increased, Timahdite and D'man have stabilized, and Béni Guil has decreased only slightly. However, the Béni Ahsen breed population decreased tremendously following the introduction of irrigation in its home zone, which caused a shift to the growing of fruit trees and the keeping of dairy cattle. The latter example illustrates that even if protective measures are in place, a major re-orientation of the farming system is liable to threaten the continued existence of traditional breeds.

Sources for more information: Boujenane (1999 and 2005)

5.2 Asia

In this region, approximately 50 percent of countries have an *in vivo* conservation programmes. In the developing countries of the region, identification of animals and the recording of pedigree and performance are lacking. Therefore, for many local breeds the basic information required to improve conservation measures is absent. *In vivo* conservation is restricted to state farms or university and institutional experimental farms. Within these programmes, phenotypic and genetic characterization has commenced.

Urbanization, the growth of the human population and increased income levels are leading to greater demand for animal products, and result in the intensification of production systems and the more widespread use of exotic breeds. Pigs and chickens play a major role in meat production in Asia. A rich diversity of breeds exists. The conservation of these two species gets a lot of attention in a small number of countries: China, Japan and Viet Nam (Table 80). Many Country Reports indicate the preference of local people for the meat of local pig and poultry breeds. This preference facilitates their future use and conservation. The speed of industrialization and specialization in the pig sector, however, gives rise to a need for special attention to be paid to the establishment of local and regional *in vitro* conservation programmes. This need is emphasized by the lack of opportunities for *in vivo* conservation of the species.

The conservation of cattle, sheep, goats and horses requires more attention in Asia, particularly in the western part of the region, where a rich diversity exists, without any significant conservation activities.

Table 80
Conservation activities in Asia

	Cattle	Sheep	Goats	Pigs	Chickens	Horses
Central Asia						
Local breeds	29	74	28	3	12	32
Conserved *in vivo*	6	18	6	0	6	2
Conserved *in vitro*	11	11	0	0	0	0
East Asia						
Local breeds	74	72	71	156	125	57
Conserved *in vivo*	22	12	13	51	80	8
Conserved *in vitro*	28	3	3	92	73	5
South Asia						
Local breeds	86	106	64	18	45	20
Conserved *in vivo*	10	18	7	1	4	0
Conserved *in vitro*	8	8	6	0	0	0
Southeast Asia						
Local breeds	50	13	19	52	61	32
Conserved *in vivo*	11	5	4	8	8	0
Conserved *in vitro*	8	4	2	0	0	0
Asia total						
Local breeds	239	265	182	229	243	141
Regional transboundary breeds	19	13	11	2	2	10
Conserved *in vivo*	49	53	30	60	92	10
Conserved *in vitro*	55	15	11	92	73	5

Refer to footnote under Table 78

Fifty percent of countries in Asia have an *in vitro* conservation programme. The state of *in vitro* conservation at the national level is very variable. Well-established genebanks exist in Japan and India, and genebanks are under establishment in China, the Republic of Korea and Viet Nam. In other countries, there is some storage of semen at AI stations, while in others, particularly in the western part of the region, no *in vitro* activities exist. Semen is preserved from all the main species, and embryos from cattle, sheep and goats are also stored. In a few countries (e.g. Japan) tissue DNA is collected from all the main species. The governments of Asia undertake these *in vitro* activities in collaboration with industry.

Box 38
Conservation strategies in China

The People's Republic of China has more than 1.2 billion people – about 22 percent of the world's population, but only around 10 percent of global farmland. The need to feed a growing population has resulted over the last 25 years in emphasis being placed on farm output. This resulted in a major importation of exotic breeds and considerable unplanned cross-breeding. However, the government realised that there was potential for a serious loss of livestock genetic diversity and, in 1994/1995, made several crucial decisions. In 1994, after drawing up a list of 576 farm animal breeds, the government issued the Regulations on Breeding Livestock Administration. Special funds were allocated to maintain indigenous breeds on state farms. The government established a National Commission for Domestic Animal Genetic Resources Administration, which hosts the National Focal Point for AnGR. A list of conservation areas for farm breeds was also produced, and state farms were linked with local farms. In 1999, a major survey was initiated in North Western and South Western Provinces, which identified 79 previously unknown breeds. The government also recognized the extinction of seven breeds to add to the ten lost up to 1983. As a result, there are around 600 recognized breeds in China.

Financial support was initiated in the Eighth Five-Year Plan (1991–1996), during which the government recognized 83 state-level key breeding farms and undertook the provision of infrastructure for several farms and conservation areas as well as some new AI stations. This support (legal and financial) has enabled Provinces, Prefectures and Counties to establish conservation areas and farms for their local breeds. In addition, pedigree (herd book) registration schemes and breed improvement schemes have been established. At present, the government is drafting an "Animal Husbandry Law", which integrates AnGR activities into mainstream animal production. It requires conservation activities and prescribes legal requirements. The proper study of local and exotic breed performance is also a requirement.

The direct result of the funding is 83 projects – most are concerned with breed conservation; about 10 percent are linked to cryoconservation schemes. Genebanks have been established, with the main mammalian bank located in Beijing, and the poultry work being carried out in Jiangsu province. Sampling of breeds for cryoconservation started in the mid-1990s and the procedures have been improved over time as a result of experience and scientific advice. The requirement is now that 250 embryos and 1 600 doses of semen are stored for each breed kept. Seventeen endangered breeds have had semen stored, and embryos are stored from 16 different breeds. This exemplifies the dilemma of whether to sample a limited number of breeds fully, or to sample more breeds, but in a limited manner. In the long term, there is a need to cover all breeds with both techniques.

China has strengthened its basic research, although comprehensive breed comparisons between local and exotic breeds remain rare. The proposal is to fully characterize and evaluate breeds in a Test Centre located in Beijing. However, the replication of the proper environments for each breed involved is problematic.

The Ministry of Agriculture (MOA) has nominated 78 breeds at national level as Key Farm Animal Breeds. For poultry, some 40 breeds are proposed for *ex situ in vivo* flocks in Jiangsu province, with each breed having at least 300 hens and the relevant number of males. The recent avian influenza outbreak has raised questions about security and the need for *in vitro* conservation alongside *in vivo* work.

The development and industrialization of China has meant that the MOA is aware of the need to ensure public awareness of conservation and the importance of livestock genetic diversity. To mark the tenth anniversary of the China National Commission for Management of Farm Animal Genetic Resources, the government released a stamp collection of the 78 key breeds. Future plans include the "China Farm Animal Diversity Network". Personnel training will be maintained to continually improve the expertise available to ensure the appropriate management of AnGR. Improved liaison between all those involved is required to achieve the most cost-effective means of maintaining China's rich store of animal genetic diversity.

Provided by Hongjie Yang and David Steane

5.3 Europe and the Caucasus

Throughout the Europe and the Caucasus region there is considerable awareness of conservation, and many breeding and conservation plans have been developed. Phenotypic characterization is carried out and several molecular genetic characterization studies have been undertaken. With the exception of the southeastern part of the region, recording of population sizes, animal identification and pedigree recording are well established.

In all important species many *in vivo* conservation programmes have been established for local breeds (Table 81). However, substantial differences exist between western and central Europe, and the

countries of the eastern parts of the region. In western and central Europe 27 countries have *in vivo* conservation programmes (Table 77). A few countries (e.g. Ireland, Finland and Germany) base their conservation policy heavily on the number of males and females in the population (effective population size). Some reports mention the low effective population size of popular cattle breeds such as the Holstein-Friesian and the Belgian Blue because of the use of a limited number of sires. Some countries (in western, northern and central Europe) have a history of AnGR conservation, and some have joined forces for reasons of efficiency (Nordic countries). In some countries, *in vivo* conservation is limited to a few species. It is performed in number of different ways. Animals are kept at a variety of farms (research farms, education farms, museums, prison farms), or are kept for nature management or as hobby animals. Part-time farming is increasing. Many of these small-scale farmers keep local breeds and try to sell regional products under quality labels in niche markets. In many Country Reports organic farming is mentioned as an opportunity for the use of local breeds. Many private organizations (NGOs) play a decisive role in *in vivo* conservation. However, the genetic management of the populations under programmes run by these organizations needs to be improved.

Political instability in the eastern part of the region and the dissolution of the Soviet Union had a serious impact on livestock systems and animal numbers. Many existing breeding and conservation programmes and the institutions involved were destroyed. Many competitive breeds and lines of cattle, pigs and chicken were developed in the Soviet Union, and were bred entirely separately from the breeds and lines of the Western World. These breeds and lines still exist, but are threatened by the introduction of Western genetics.

Box 39
Denmark – opportunities for *in vivo* conservation

In Denmark, beef cattle, horses, sheep, goats, rabbits, ducks, geese, turkeys, ostriches and deer are mainly kept by part-time, leisure-time and hobby breeders. There are a number of industrialized production enterprises, especially among beef cattle, turkeys and ducks, but most herds are small with medium or low levels of investment. The part-time, leisure-time and hobby breeders keep many different breeds. They, therefore, constitute an important target group with respect to conservation and utilization of AnGR. Leisure-related aspects of livestock keeping are of considerable significance in Denmark. Keeping farm animals is an important recreational activity for many people, and many others appreciate the effects that, grazing cattle, horses, sheep and goats have on the landscape and environment.

Source: CR Denmark (2003)

Table 81
Conservation activities in Europe and the Caucasus

	Cattle	Sheep	Goats	Pigs	Chickens	Horses
Local breeds	277	458	170	165	608	269
Regional transboundary breeds	28	79	13	17	45	38
Conserved *in vivo*	137	175	51	47	101	113
Conserved *in vitro*	106	51	15	28	6	23

Refer to footnote under Table 78

Most *in vitro* conservation programmes are found in western and central Europe. In many cases this is restricted to the storage of semen from a limited number of cattle and sheep breeds. A few countries (the Nordic countries, France, the Netherlands, Poland, the Czech Republic and Hungary) have genebanks preserving semen from the main species. In some cases, embryos of cattle, sheep and pigs are also preserved, and in a few countries, cattle oocytes or tissue DNA are stored. These banks are recently founded or are under construction. A strong collaboration with the animal breeding industry exists in most countries. The genebanks need to be further developed – with respect, for example, to ownership and access, information and documentation, and optimization of the core collection and the ratio between gametes and embryos. Despite the presence of a rich AnGR diversity in combination with real threats (such as political instability) *in vitro* conservation programmes are largely absent in the eastern parts of the region, with the exception of Ukraine.

5.4 Latin America and the Caribbean

In this region, the number of countries with active conservation programmes is low, although many countries report a very rich national biodiversity. Most of the species and breeds present in this region were imported from other regions hundreds of years ago. Some breeds were further developed in straight-breeding programmes. New composite breeds adapted to the specific and often extreme local conditions were also developed. In other cases, continuous cross-breeding takes place. As straight-breeding plays a less significant role than in Europe, conserving (pure) breeds is often not regarded as such a high priority. This does not apply to South America's unique domesticated species (e.g. llamas, alpacas and guinea pigs).

The quality of *in vivo* conservation activities is highly variable. Brazil has an intensive programme of *in vivo* conservation, while some countries lack any activity. In much of the Caribbean and Central America, animal identification and registration, performance recording and breeding are not developed, and this creates a weak base for conservation activities. In many South American countries, the export market makes it attractive to invest in animal identification and performance recording, and this contributes to the establishment of active breeding and conservation programmes.

In vivo conservation is mainly limited to cattle and horses kept at university and institutional farms (Table 82), which often function as nucleus breeding herds. In a few countries, molecular characterization activities have been initiated to support conservation decisions. In the counties which do have conservation activities, initiatives are taken by governments, universities and institutes.

Table 82
Conservation activities in Latin America and the Caribbean

	Cattle	Sheep	Goats	Pigs	Chickens	Horses
Caribbean						
Local breeds	19	5	3	11	7	1
Conserved *in vivo*	0	0	0	0	0	0
Conserved *in vitro*	0	0	0	0	0	0
South America						
Local breeds	74	36	20	35	43	39
Conserved *in vivo*	43	5	7	2	0	5
Conserved *in vitro*	15	5	6	2	0	5
Central America						
Local breeds	36	6	3	21	34	25
Conserved *in vivo*	33	5	8	5	0	16
Conserved *in vitro*	1	0	0	0	0	0
Latin America and the Caribbean						
Local breeds	129	47	26	67	84	65
Regional transboundary breeds	8	2	2	3	1	5
Conserved *in vivo*	76	10	15	7	0	21
Conserved *in vitro*	16	5	6	2	0	5

Refer to footnote under Table 78

In vitro conservation is limited to the storage of semen and sometimes also of embryos from a few breeds. The initiatives for establishing cryobanks are mainly taken by governments with help from universities and institutes. Brazil is the first country in this region to have established a genebank.

Box 40
Brazil – implementation of a genebank

To minimize the threat of extinction faced by locally adapted breeds, the National Research Centre for Genetic Resources and Biotechnology – Cenargen, of the Brazilian Agricultural Research Corporation (Embrapa), included, from 1983, the conservation of AnGR in its conservation programme, which up to that date had included only plants. From that time, the conservation of AnGR began to be carried out, under the coordination of Cenargen, by various Embrapa research centres, universities, state research corporations and private farmers. The animal conservation programme includes the following stages: (a) identification of populations in an advanced state of genetic dilution; (b) phenotypic and genetic characterization; and (c) evaluation of their production potential. Conservation is being carried out in conservation nuclei, maintained in the habitats where the animals were naturally selected (*in situ*). At the same time, embryos and semen are stored (*ex situ*) at the Animal Germplasm Bank (AGB) in Brasilia. It is important that economic use for each one of the breeds being conserved is identified. Research alone is not able to conserve the endangered breeds, and a partnership with private breeders is of fundamental importance to the success of the programme.

Source: CR Brazil (2003)

5.5 Near and Middle East

The primary aim of the governments of the countries in this region is to increase animal production to decrease imports of food of animal origin. Thus, there is a focus on high-input systems. High-output exotic cattle and chicken breeds are imported. There is very little drive to improve or to conserve the local animals despite a rich breed diversity (Table 83).

Table 83
Conservation activities in the Near and Middle East

	Cattle	Sheep	Goats	Pigs	Chickens	Horses
Local breeds	43	50	34	1	24	14
Regional transboundary breeds	0	4	0	0	0	0
Conserved *in vivo*	5	4	3	0	0	0
Conserved *in vitro*	1	0	0	0	0	0

Refer to footnote under Table 78

CR Iraq (2003) mentions some *in vivo* conservation activities in the main species – cattle, sheep and goats, but details are not provided. In other countries, there is generally a lack of awareness of the value of the local breeds and the possibilities to improve and conserve them. Throughout most of the region, no identification, registration or performance recording exist. Characterization activity is extremely limited. No *in vitro* conservation programmes exist in this region.

5.6 North America

The United States of America and Canada have a close inter-relationship with respect to livestock. Canada provides a lot of livestock and livestock products to the United States of America. The latter is the base for breeding stock used in Canada.

Both countries have very active NGOs playing an important role in the *in vivo* conservation of the many local breeds. Support from scientists for these organizations in terms of their genetic management activities could, however, be improved. Universities and institutional farms take care of the conservation of dual purpose breeds and experimental selection lines of chickens. However, many of them are threatened by limited budgets for these activities. A lot of work on breed characterization is carried out by universities and research institutes.

In the United States of America and Canada, AnGR are seen as a strategic resource for national food security, which may be threatened by bioterrorism. This is one of the reasons why the United States of America invested in the establishment of an *in vitro* conservation programme and a genebank (Table 84). Collections are being built up very quickly, in close collaboration with the industry. Breeding companies use the genebank as a back up of their breeding work. In Canada, a programme for *in vitro* conservation has been developed and will be implemented in the near future. There will be close

collaboration between the United States of America and Canada in genebank activities. They share information and documentation programmes, and are discussing taking care of each other's back-up *in vitro* collections.

Table 84
Conservation activities in North America

	Cattle	Sheep	Goats	Pigs	Chickens	Horses
Local breeds	29	35	3	18	12	23
Regional transboundary breeds	3	6	5	1	1	3
Conserved *in vivo*	1	1	0	0	0	2
Conserved *in vitro*	36	39	11	18	8	0

Refer to footnote under Table 78

Box 41
United States of America – priorities in conservation programmes

Priorities are subdivided into biological issues and physical capacity issues. From the biological perspective, priorities include:

1. completing breed-level collections of cryopreserved germplasm and tissue;

2. increasing levels of *in situ* conservation by private and public entities;

3. creating a more thorough understanding of within and between-breed genetic diversity; and

4. developing more efficient and reliable cryoconservation protocols for semen, embryos and oocytes.

Physical capacity priorities include:

1. continuing the development of NAGP (National Animal Germplasm Program) infrastructure and staffing;

2. increasing awareness and support for university conservation efforts;

3. leveraging the complementarities of different federal agency programmes; and

4. increasing industry awareness of, and involvement in, various aspects of managing animal genetic diversity.

Source: CR United States of America (2003)

5.7 Southwest Pacific

In general, governments in this region show little awareness of the strategic value of the genetic diversity of livestock. In Australia, private farmers and NGOs are active in the conservation of small populations of threatened cattle breeds, and private breeding companies and NGOs store cattle semen and embryos.

Table 85
Conservation activities in the Southwest Pacific

	Cattle	Sheep	Goats	Pigs	Chickens	Horses
Local breeds	26	35	11	12	17	22
Regional transboundary breeds	0	3	1	0	0	0
Conserved *in vivo*	13	0	0	0	0	0
Conserved *in vitro*	0	0	0	0	0	0

Refer to footnote under Table 78

Box 42
Australia – involvement of diverse stakeholders

In Australia, mainstream breeding of livestock has focused on achieving sustainable industries through adapted and productive livestock. Genetic inputs from many continents have been used to achieve this goal, and conservation of adaptive genotypes has been achieved by making the animals desirable for production purposes and ensuring their presence in sufficient numbers to provide responses to selection over the long term. Conservation of rare breeds in Australia is largely in the hands of private breeders and breed societies, or NGOs such as the Australian Rare Breeds Trust. These special interest groups support the *in situ* and on-farm conservation of breeds through breeding plans and genetic advice. *Ex situ* conservation is effected through genebanks maintained by breeding companies and conservation NGOs.

Source: CR Australia (2004)

6 Opportunities for improving conservation programmes

The effectiveness of the conservation of genetic diversity can be measured utilizing criteria such as the effective population size, the number of sires and dams used in each generation, and the mating schemes practised. Unfortunately, information on the number of animals conserved in *in vivo* programmes and the number of sires and dams from which genetic material is conserved *in vitro* is available only in a few countries. Thus, it is difficult to assess the effectiveness of existing activities. Some of the improvements required to establish sound conservation programmes can, however, be identified and are discussed below.

The intensification of animal production results, in some countries, in large areas of land being given over to nature conservation. Nature management facilitates *in vivo* conservation of herbivore species, but in some cases, the animals are kept outside their original environment and are not used for the type of production for which they were developed. Large populations of animals are needed for these activities, which, if managed properly (in genetic terms), offer a great opportunity to conserve genetic variation for future use.

While at a global level, food of animal origin will to a large extent be produced in high-input–high-output systems with highly specialized breeds or cross-breeds, small-scale farming continues to be important, and the significance of organic farming is increasing. These systems require well-adapted dual-purpose or multipurpose breeds. These breeds are better fitted to the production goals of less-intensive farming systems than are highly specialized breeds or cross-breeds. However, transnational breeding organizations rarely invest in these breeds because of the limited size of the markets. More emphasis should be given to the development of these breeds and to the conservation of their genetic diversity.

The development of special products for niche markets offers the possibility to use local breeds and to make them profitable again. This strategy can be enhanced by fostering the notion of "terroir" or the use of labels of origin. Conservation on a small scale on farms oriented towards producing for niche markets can lead to a profitable use of local breeds, but often results in a loss of genetic variation within the population. This can also be the case in small populations kept by hobby farmers if inbreeding is not properly controlled. However, small farmers and hobbyists play a very important role in the conservation of between-breed variation in chickens, horses, sheep, goats and cattle. The education of these livestock keepers in the genetic management of small populations should be improved, as should professional support from governmental and academic institutions. Proper breeding strategies coupled with AI and ET could effectively be used to maintain if not increase genetic diversity under the conditions of small-farm conservation or niche-market production.

In modern breeding schemes carried out by breeding organizations, the conservation of within-breed genetic diversity is often taken into account. Optimization techniques are well developed and effective. When, for example in cattle breeding, these techniques are introduced in the mating schemes used by farmers, inbreeding problems at the production level can be minimized. At present, there is a tendency to broaden breeding goals to include fitness traits as well as production traits. This will have a positive influence on the effective population size and on the maintenance of the genetic diversity

within the breeds in question. For some breeds, it might be wise to use breeding stock from related populations to enlarge the effective population size. Another alternative is to select the semen of "lost" founders from genebanks, and use these sires again.

Cryoconservation is a proven technology and is an important complement to *in vivo* breed conservation. Up to the present time, it has been used mainly to conserve genetic diversity within breeds; it is attractive to the breeding industry as a back up for their breeding material. Genebanks have to be further developed, with respect, for example, to ownership and access, storing back-up collections, information and documentation, optimization of the core collection, and the ratio between gametes and embryos.

7 Conclusions and priorities

In many countries in Africa, eastern parts of the Europe and the Caucasus region, the Near and Middle East, Central and South Asia, and the Caribbean, conservation programmes need to be developed. These regions and subregions have a rich diversity of AnGR, but its value is not sufficiently recognized by the national authorities. In most countries, awareness has to be increased in order to obtain financial resources for the improvement and conservation of local breeds. Capacity to develop animal breeding and production, and to implement the genetic management of local populations should be a high priority. In many developing countries, multilateral or bilateral aid programmes for conservation are necessary. Intercountry, subregional and regional programmes should be encouraged and supported through external technical and financial assistance. The establishment of regional conservation programmes and genebanks for regional transboundary breeds should be a high priority particularly in developing countries.

The number of breeds that are potential candidates for conservation is large, and conservation programmes for animals are expensive. Thus, in national conservation programmes, careful attention should be paid to the selection of breeds and methods for conservation. Effective prioritization of breeds for conservation programmes is facilitated by phenotypic and genetic characterization, and by knowledge of the size and structure of the population. Obtaining information on population structure and effective population size is a great challenge and requires cooperation with breeders and their registries.

To implement an adequate breed conservation programme (in which the conservation of the diversity within the breed is very important), the pedigree of the individual animals must be known, a required minimum number of males and females per generation must be kept to avoid random drift, and a mating scheme should be introduced to avoid inbreeding. *In vivo* conservation programmes must include identification and registration of animals, performance recording, and monitoring of populations and population sizes. Regional cooperation, establishment of intercountry or regional genebanks for cryoconservation is of particular importance.

In poultry, pigs and (beef and dairy) cattle, transnational companies develop only a limited number of breeds and lines. The breeding and production activities of these companies are spreading in Asia and Africa. Improved, highly selected breeds and lines will be used to meet the growing demand for meat, milk and eggs in the coming years. In these circumstances, many recently developed (dual-purpose) and local breeds of cattle, pigs and poultry have to be considered for conservation. The high speed of industrialization and specialization in pig breeding, in combination with a lack of *in vivo* conservation opportunities for this species requires that special attention should be paid to the *in vitro* conservation of pig populations (local breeds and recently developed lines). For all species, breeding programmes to improve and conserve local breeds and to enhance their performance in cross-breeding systems with exotics should be developed.

For local and recently developed breeds and lines that will not be used extensively in the future, opportunities for *in vivo* conservation should be further explored: nature management, organic farming, participatory breeding, niche markets and hobby farming. In sheep and in horses, production and breeding objectives have changed dramatically in recent years, with major consequences for the use and conservation of genetic resources. These developments illustrate the importance of

maintaining the genetic diversity necessary to meet new objectives. In sheep, between-breed diversity is threatened by a sharp decease in the size of the population in many regions.

Education programmes on genetic management should have a high priority. In all regions, farmers and their organizations and advisors, require instruction on sustainable use, development and conservation of AnGR. Support for hobbyists and NGOs to improve their genetic management is also required. In many universities in developed countries these topics are increasingly integrated in the curricula for agricultural students. However, the number of these students is decreasing.

To safeguard genetic diversity, all countries should have their own or shared genebanks that contain cryopreserved material of their locally developed breeds and lines, to protect them against unpredictable threats. Because many transboundary breeds exist, coordination between countries is required. Cooperation would be facilitated if national and regional genebanks operated under internationally agreed protocols. These should include zoosanitary requirements for cryopreserved material, in addition to phenotypic description and genetic characterization. However, in some circumstances, it may be appropriate for countries to decide to immediately commence the establishment of a national gene bank, and tackle sanitary requirements and characterization at a later stage.

The operation of genebanks would also be improved by the regulation of ownership, access and the publication of documentation, and by the optimization of the contents of the collection. To facilitate the establishment of genebanks, training facilities are needed for cryoconservation techniques such as the sampling of breeds and individuals within breeds, and freezing and maintenance of semen, oocytes and embryos. *In vivo* and *in vitro* conservation sites and collections should be protected against human-induced and natural calamities by variety of measures, including the use of widely separated locations at both national and international levels.

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SECTION D: REPRODUCTIVE AND MOLECULAR BIOTECHNOLOGY

1 Introduction

The development of biotechnologies in the fields of breeding, reproduction and molecular genetics has advanced considerably in recent years. Among reproductive technologies, AI and multiple ovulation followed by embryo transfer (MOET) have already had a major impact on livestock improvement programmes in developed countries. These technologies speed up genetic progress, reduce the risk of disease transmission, and expand the number of animals that can be bred from a superior parent. The field of molecular genetics is also rapidly developing; characterization based on molecular markers, and marker assisted selection offer new opportunities in AnGR management (FAO, 2004). However, the extent to which the technologies are utilized varies greatly from country to country and between regions. The following chapters present an overview of the information presented in the Country Reports on the utilization of biotechnologies.

2 Global overview

Table 86 presents a region-by-region overview of the proportion of countries reporting the use of different classes of biotechnology. It can be seen that AI is by far the most widely used biotechnology. Nonetheless, particularly in the Africa and Southwest Pacific regions, there are many countries where it remains unavailable. In the case of ET and molecular techniques, the gap between the developed and developing regions is even greater. As Table 87 illustrates, the use of biotechnologies tends to be biased towards cattle. The table shows that this bias is greatest with respect to ET, but it can also be seen that in most regions the use of AI is also dominated by the cattle sector. In the Africa region in particular, few countries have extended the use of AI to other species. The evidence for this species bias is rather less clear in the case of molecular genetic technologies. The number of countries reporting the use of these technologies is quite low. However, among these countries, a relatively high number report studies of molecular characteristics in at least one species other than cattle. Nonetheless, cattle remain the single dominant species in most regions, particularly where commercial applications of the molecular technologies are concerned. Further details of the distribution of biotechnology use, and of the species to which the technologies are applied are included in the following regional descriptions.

Table 86
Use of biotechnologies by region

		Artificial Insemination		Embryo Transfer		Molecular Genetic Technologies	
Region	No. of CRs	No. providing info.	Reporting use of the technology	No. providing info.	Reporting use of the technology	No. providing info.	Reporting use of the technology
Europe	39	39	97%	25	64%	29	83%
Africa	42	42	74%	30	17%	29	14%
Asia	25	22	86%	17	47%	16	50%
Latin America and the Caribbean	22	22	95%	14	86%	15	73%
Southwest Pacific	11	11	55%	10	10%	9	11%
North America	2	2	100%	2	100%	2	100%
Near and Middle East	7	6	100%	3	33%	5	40%

Table 87
Use of biotechnologies by species

	Artificial Insemination			Embryo Transfer			Molecular Genetic Technologies		
Region	No. with info on species	Reporting use of the technology: In cattle	In other species	No. with info on species	Reporting use of the technology: In cattle	In other species	No. with info on species	Reporting use of the technology: In cattle	In other species
Europe	38	100%	66%	11	100%	36%	18	89%	100%
Africa	31	100%	10%	4	100%	0%	3	100%	33%
Asia	18	94%	56%	6	100%	50%	7	86%	100%
Latin America and the Caribbean	21	100%	71%	12	100%	33%	9	78%	89%
Southwest Pacific	5	100%	80%	2	100%	0%	0	-	-
North America	2	100%	50%	0	-	-	1	100%	100%
Near and Middle East	6	100%	33%	1	0%	100%	2	0%	100%

2.1 Africa

The Country Reports indicate that AI is the reproductive biotechnology most commonly used in the management of AnGR in Africa. The Country Reports generally express an aspiration for greater use of the technology, mainly to facilitate breeding programmes and the introduction of exotic germplasm. This aspiration corresponds to the overall objective expressed in most African Country Reports of promoting food security through increased output of livestock products. In many cases, the desire for more widespread use of AI is tempered by concern regarding the implications for genetic diversity of its inappropriate or uncontrolled use. A number of Country Reports from the region also mention the potential use of AI facilities for cryoconservation purposes.

Thirty-one out of 42 countries report the use of AI. A few other countries report that AI has been carried out experimentally in the past, but never applied routinely, or that former AI programmes have been abandoned through lack of financial resources or other constraints. AI use in Africa is predominantly focused on cattle. All 31 Country Reports indicating the use of AI mentioned that the technology is used in cattle. Two countries report the use of AI in sheep, one in goats, one in horses and one in pigs. The semen used for AI tends to be from exotic breeds rather than local breeds. Nineteen countries indicate that AI is performed using semen from exotic cattle breeds, two report using semen from local breeds, and six report use of both local and exotic semen. Where details of programmes are provided, the objective is often the upgrading of indigenous livestock using semen from exotic breeds, most frequently of dairy cattle. Exotic beef cattle semen is also utilized in a number of countries.

Some Country Reports from West Africa mention the use of exotic semen for cross-breeding with trypanotolerant cattle breeds (CR Guinea, 2003; CR Côte d'Ivoire, 2003). A limited number of AI programmes utilizing semen from indigenous animals are reported, including in one country the use of semen from trypanotolerant cattle (CR Côte d'Ivoire, 2003). CR Madagascar (2003) notes the use of AI in *in situ* conservation programmes for the endangered Renitelo cattle breed. However, even in countries where indigenous breeds are included in AI programmes, the balance appears to favour exotics. CR Botswana (2003) indicates that 94.1 percent of AI services performed during the 1987 to 1995 period were carried out using the semen of exotic breeds. The use of AI by smallholders is largely restricted to dairy producers, and is concentrated in peri-urban areas. A small number of Country Reports mention efforts to promote a wider diffusion of the technology, including in less

easily accessible areas. CR Senegal (2003) notes considerable use of AI to introduce exotic germplasm for the breeding of race horses.

There is substantial variation from country to country in terms of the development of facilities and human resources for the implementation of AI programmes, in terms of the availability of services to the farmer, and in terms of the providers involved in service delivery. The public sector is the most frequently reported provider of AI services in the region. Among the 27 Country Reports providing information on service providers, 26 mention the public sector and 12 mention private companies. NGOs are mentioned as providers of AI services in eight Country Reports, while breeders' organizations are mentioned in two Country Reports (CR Burkina Faso, 2003; CR Madagascar, 2003). CR Niger (2003) mentions collaboration between two Italian universities, a local university and a local research station in establishing an AI programme for cattle. CR Zambia (2003) indicates that individual private farmers have imported exotic semen for the purposes of improving their cattle herds. A few countries have quite extensive AI programmes in place. Botswana, for example, in the context of its policy to improve the national herd, has a number of AI camps throughout the country and subsidizes the supply of semen to traditional farmers (CR Botswana, 2003).

Several countries report that problems with the financing of government services are a constraint to the provision of AI. Increased involvement by the private sector is noted as an objective in several Country Reports. A few countries are able to report significant progress in this direction (for example CR Kenya, 2004 and CR Zambia, 2003). CR Zambia (2003) notes that the private sector has taken the lead in providing imported semen, while the government trains and supervises AI technicians. However, as the figures above indicate the role of the private sector appears to be limited or absent in most countries. Few Country Reports discuss constraints to the involvement of the private sector in any detail. However, CR Côte d'Ivoire (2003) mentions that the single private operator in the country had ceased activities as a result of financial difficulties.

Five countries (CR Côte d'Ivoire, 2003; CR Kenya, 2004; CR Madagascar, 2003; CR Zambia, 2003; and CR Zimbabwe, 2004) report the use of ET technologies. Use of the technology appears to be limited. In one country, the technology is reported only to have been used on Holstein-Friesian cattle on a single private farm (CR Madagascar, 2003). CR Côte d'Ivoire (2003) notes that some individual cattle owners have introduced Brazilian Zebu genetic material through the import of frozen embryos. In Zimbabwe, the technology is reported to be available through two private breeding companies (CR Zimbabwe, 2004). Several Country Reports state that the introduction of ET is an objective. However, the specific role that the technology could be expected to play in the management of AnGR in the local production systems is rarely elucidated. There is a lack of discussion of how it could be integrated within organized breeding programmes. The potential use of the technology for purposes of cryoconservation is, however, noted in several Country Reports. Studies based on the use of molecular markers are mentioned in only four Country Reports from Africa.

2.2 Asia

Among the Asian Country Reports, 19 out of 22 countries providing information indicate the use of AI. From 18 countries providing details of the species inseminated, 17 mention cattle, eight pigs, five buffaloes, four sheep, three chickens, two goats, two horses, one camels and one ducks. Details of the breeds used as the source of semen are limited. However, in the case of cattle eight Country Reports indicate the use of semen from both local and exotic breeds, four mention only exotic breeds, and two mention only local breeds. Provision of AI services appears to be dominated by the public sector. Of 17 Country Reports giving details of service providers, all 17 mention the public sector, with 6 mentioning the private sector, five breeders' organizations, four NGOs and one universities. There is much variation from country to country in the extent to which AI is used. In an industrialized country such as Japan, almost all cattle breeding (99.4 percent in dairy herds and 97.8 percent in beef herds) is carried out using AI (CR Japan, 2003). In most other Asian countries, services are much more limited and tend to be focused on the dairy sector and peri-urban production systems. Several Country Reports indicate that service coverage is limited by financial and technical constraints. Indeed, a few Country Reports indicate a decline in the use of the technology.

The desire to establish or to increase the availability of AI services is expressed as an objective in many Country Reports. In a number of countries AI has served as a means of introducing exotic germplasm for the purposes of cross-breeding with local breeds. The technology has been used in the development of synthetic breeds incorporating both exotic and indigenous genes – an example being the Jermasia goat (CR Malaysia, 2003). In some cases, AI has also been used to upgrade cross-breeds back to indigenous breeds through back-crossing to promote hardiness. This approach has been applied, for example, using Kedah-Kelantan semen in cattle herds introduced to tree plantations (ibid.). In some cases AI services supply semen from indigenous breeds. CR Pakistan (2003) for example reports the use of semen from Sahiwal cattle. However, the same Country Report indicates that the collection of semen from some other indigenous cattle breeds was discontinued because of a lack of demand.

Eight out of 17 Asian countries providing information on the matter indicate some use of ET technology. Among the six countries providing details of the species in which the technology is implemented, 6 mention cattle, two buffaloes, one horses and one goats. The breeds involved are rarely detailed, but one Country Report mentions the transfer of embryos from indigenous cattle breeds and one mentions exotic breeds. In most countries, ET is used on a very limited scale and is often largely confined to research. CR Myanmar (2004) notes that an ET project initiated in the country met with some success at first, but soon declined because of a lack of funding. CR Malaysia (2003) mentions that ET technology was used in the development of the Mafriwal cattle breed. The potential role of the technology in cryoconservation programmes is, again, noted in several Country Reports.

Eight out of 16 Asian countries providing information on the matter report the use of molecular techniques. Among these countries, 6 specify genetic distancing studies, and two mention marker assisted selection. Among the 7 countries providing details of the species involved in molecular characterization studies, six mention cattle, five chickens, four sheep, four goats, four pigs, three buffaloes, two ducks, two horses, one camels, one deer, one quails and one guinea fowl. In the case of distancing studies, among the five countries providing details of the species involved, four mention chickens, three cattle, three sheep, three goats, two pigs, two buffaloes, two horses, one ducks, and one deer. With regard to the breeds involved, systemized studies on Asian breeds are being conducted by the Society for Research on Native Livestock in Japan including analysis based of genetic relationships based on mitochondrial DNA polymorphisms and other DNA markers (CR Japan, 2003). Native Japanese breeds covered by the studies include Mishima cattle and Kuchinoshima feral cattle (ibid.).

Other biotechnologies are very largely restricted to the most industrialized countries in the region. The use of *in vitro* fertilization is mentioned in CR Japan (2003) and CR Malaysia (2003). CR Japan (2003) indicates that a number of other reproductive biotechnologies with potential for use in the propagation of rare breeds, as well as commercial applications, have been utilized at an experimental level. The technologies include sperm microinjection to fertilize eggs – applied in pigs; primordial germ cell (PGC) and chimera germline techniques – applied in chickens; and cloning technologies – used in cattle, pigs and goats (ibid.).

2.3 Europe and the Caucasus

Thirty-eight of 39 countries in the region report the use of AI. All 38 mention the use of the technology in cattle, 23 in pigs, 16 in sheep, nine in horses, eight in goats, two in rabbits, and one in chickens. Most countries which give details report using semen from both local and imported breeds of cattle, pigs and sheep. While almost all countries are able to report the existence of some AI provision, there is great variation in the extent to which the technology is utilized. In many countries, particularly in western Europe, AI is widely available and used throughout the livestock sector, particularly in dairy cattle. However, a number of Country Reports from the eastern parts of the region, where the livestock sector has often faced substantial problems, indicate that capacity to provide AI services is severely limited as a result of the disintegration of formerly existing infrastructure.

A range of providers are involved in the delivery of AI services. Of the 32 countries giving details of providers, 24 mention the private sector, 20 the public sector, 19 breeders' organizations and three universities. In the countries of the eastern part of the region, services are more likely to be provided by the public sector. Conversely, elsewhere in the region, the private sector and farmers' organizations are the most frequently mentioned service providers, although in many countries there is still considerable involvement or support from the public sector. CR Turkey (2004), for example, mentions the provision of subsidies to private sector providers of AI. Transfer of services to the private sector has not always been without problems. For example, CR Romania (2003) notes that reorganization and greater independence of AI institutes, along with the introduction of service charges led to a decline in the uptake of the technology.

In some countries, AI using imported semen has been widely used to increase the production levels obtained from local breeds. However, some concerns are raised in the Country Reports. Attempts to upgrade local livestock using exotic semen have sometimes failed because the resulting cross-bred animals have proved to be poorly adapted to the local conditions. There is also a potential threat to genetic resource diversity. According to CR Greece (2004), inappropriate and unplanned use of AI contributed markedly to the loss of some indigenous breeds.

Sixteen of the 25 countries providing information on the matter report the use of ET. Of the 11 countries providing details of the species involved, all 11 mention cattle, three sheep, two goats, one pigs, one horses and one rabbits. Where specified, ET is carried out using embryos from both imported and local breeds of cattle. Again, it is the dairy industry that is the main user of ET. The technology has contributed significantly to increasing the rate at which selective breeding has contributed to increasing the output of livestock products. However, as a result of the costs involved in applying the technology it is less widely used than AI, and in some countries, ET programmes have ceased as a result of the high costs. In the case of ET, out of eight countries providing details of service providers four mention the private sector, four the public sector, four breeders' organizations and three universities. Other reproductive technologies such as embryo sexing, cloning and transgenetics are mentioned in a very few Country Reports as subjects for research.

Twenty-four out of 29 Country Reports providing information on the matter indicate the use of molecular techniques. Marker assisted selection is used in commercial animal production in a number of European countries. The technology can be applied to eliminate a number of undesirable traits related to health or fertility from livestock populations, and to assist selective breeding for greater productivity.

The importance of ensuring that information on molecular biotechnologies, including their economic benefits, are made available to farmers and breeders' organizations is noted in one Country Report (CR Hungary, 2003). Another Country Report highlights the prospect that molecular biological methods will facilitate the discovery of genes for economically important traits in locally adapted breeds, thereby enhancing their value in breeding programmes (CR Germany, 2003). However, the same Country Report raises the concern that the use of molecular technologies in the context of market-driven attempts to increase production could exacerbate a trend towards inbreeding and loss of genetic diversity within livestock populations. Similar apprehensions are expressed in a small number of other Country Reports. Genetic distancing studies are considered important from the point of view of planning and prioritizing conservation efforts. One Country Report, however, notes that progress to this end has been limited as interest in the subject is largely restricted to universities, and funding is limited (CR Belgium, 2005). Another Country Report puts forward a potential role for such techniques in relation to the niche marketing of livestock breeds on the grounds of their close association with a particular geographical location (CR France, 2004).

Among the Country Reports providing details of the use of molecular technologies, 11 specify the implementation of molecular genetic distancing studies and seven mention the use of marker assisted selection. Out of 17 countries providing information on the species involved in molecular characterization studies, 14 mention cattle, 13 sheep, 11 pigs, eight horses, five goats, three chickens, one donkeys, one turkeys and one geese. Out of 12 countries providing information on the species involved in distancing studies, 11 mention sheep, nine cattle, five horses, four pigs, three chickens,

three goats, two geese, one ducks, one donkeys, one rabbits, and one deer. Out of four countries providing information on the species in which marker assisted selection is practised, four mention cattle, four pigs, one chickens and one horses. Details of the specific breeds to which technologies have been applied are quite limited in the Country Reports. Among the local breeds for which molecular characterization or distancing studies are mentioned in the Country Reports are the Turoplje and Black Slavonian pigs, Ruda sheep, sheep of the islands of Rab, Pag and KrK (CR Croatia, 2003); Wallachian and Sumava sheep, Brown goats and White goats (CR Czech Republic, 2003) and the Karakachanska sheep (CR The former Yugoslav Republic of Macedonia, 2003).

2.4 Latin America and the Caribbean

AI is widely practised in the countries of this region. Twenty-one out of 22 Country Reports indicate the use of the technology. All 21 countries report the use of AI in cattle, 13 mention pigs, eight sheep, eight goats, five horses, one rabbits, one buffaloes, one donkeys, one llamas, one alpacas and one turkeys. With regard to the cattle breeds providing the semen used for AI, 13 Country Reports mention only exotic breeds, while four mention both indigenous and exotic. In the cases of sheep, five Country Reports mention exotic breeds and one mentions both exotic and local. In the case of pigs, 9 Country Reports mention only exotic breeds while one mentions both local and exotic.

It is clear that the predominant objective is to increase the genetic merit of livestock populations using semen from exotic breeds. In many countries, semen is imported from overseas. Use of the technology is most common in the dairy sector. In some countries it is also quite widely used by commercial producers of beef cattle, pigs and small ruminants. However, there is marked variation between countries and between production systems in terms of the extent to which AI is used. In many small-scale or low external input systems, use of the technology is very limited. A number of countries indicate that improving the provision of AI services is an important objective. A small number of Country Reports, however, mention concerns regarding the decrease of genetic diversity arising as a result of the inappropriate use of AI. With regard to the providers involved in the delivery of AI services, the private sector plays an important role in this region. Of 17 Country Reports giving details of service providers, 11 mention the public sector, 9 mention the private sector, and five breeders' organizations. CR Barbados (2005) mentions the provision of subsidies to farmers' organizations for the purchase of semen for AI.

ET technology is increasingly being used by commercial livestock producers in several countries of the region. Twelve Country Reports, out of 14 providing information, report the use of ET. All 12 mention the use of the technology in cattle, three in horses, two in goats, two in sheep, one in llamas, one in alpacas and one in donkeys. Transplanted embryos largely come from exotic breeds – the six countries that provided details of the cattle breeds involved indicate the use of embryos only from exotic breeds. As in the case of AI, though on a more limited scale, use of ET technology is dominated by the dairy industry, with restricted use in other types of commercial livestock production. Some Country Reports indicate the importation of embryos from overseas. Information on the providers of ET services is limited. However, the CR Brazil (2004) and CR Chile (2003) mention private sector organizations involved in the provision of the technology. Additionally, two Country Reports indicate some commercial use of *in vitro* fertilization, while one mentions the development of embryo sexing and cloning technologies.

Eleven countries, out of 15 providing information, indicate some use of molecular techniques. With regard to molecular characterization studies, out of 9 countries providing information on the breeds involved, seven mention cattle, three sheep, three pigs, two chickens, two horses, one goats, one buffaloes, one llamas, one alpacas, one vicuñas, one guanacos and two unspecified camelids. Several countries indicate that locally adapted breeds have been included in such studies. CR Peru (2004) mentions molecular investigations of the genetic distances between South American camelid species. Few Country Reports, however, indicate that molecular technologies have been incorporated in breeding programmes. CR Colombia (2003) notes the potential significance of marker assisted selection programmes utilizing the genes of the Blanco Orejinegro cattle breed, which is reported to show resistance to brucellosis, and which has been the object of molecular characterization studies.

2.5 Near and Middle East

In this region all six countries providing information on the matter report the use of AI. With regard to the species involved, all 6 mention cattle, one camels and one rabbits. One Country Report (CR Oman, 2004) mentions the use of ET in camels. The semen used in AI programmes is largely obtained from exotic breeds, either from local populations or imported. A number of Country Reports note that the use of AI has had an adverse effect on genetic diversity and contributed to the decline of local livestock breeds. One Country Report (CR Syrian Arab Republic, 2003) mentions some use of semen from a local cattle breed (Shami). Some Country Reports indicate that the development of AI programmes for local breeds of sheep, goats and/or buffaloes is a priority. CR Syrian Arab Republic (2003), for example, notes that the local Awassi sheep and Shami goats are much sought after in neighbouring countries for breeding, and that plans are in hand to develop AI and ET programmes to meet the demand. Among 6 countries giving information on service providers, five mention the public sector, four the private sector and two breeders' organizations. Some Country Reports, however, indicate constraints to the provision of AI, such as a lack of trained personnel. Several Country Reports note the potential use of AI and ET technologies in cryoconservation. The use of other biotechnologies is limited. One Country Report (CR Jordan, 2003) indicates molecular characterization and genetic distancing studies in indigenous goats, while another (CR Egypt, 2003) notes that molecular genetic studies of buffalo, sheep and goats have recently been initiated with the aid of regional and international organizations.

2.6 North America

In the United States of America and Canada reproductive biotechnologies are readily available. AI is widespread in the dairy and pig industries, and is used to a lesser extent in other sectors such as beef cattle and small ruminants. Concern is expressed at the role of AI in contributing to a reduction in the effective population size of some dairy cattle breeds. Details of the utilization of other biotechnologies are limited in the Country Reports from this region. In the United States of America, molecular characterization studies have been carried out, by industry and public sector institutions, for the most widely kept breeds of dairy cattle and pigs, and also in a number of beef cattle breeds (CR United States of America, 2003). Molecular markers are particularly used for the identification of recessive defects in bulls used for AI. Molecular studies, providing measures of within and between-breed genetic diversity are also used by the National Animal Germplasm Program (NAGP) in the planning of conservation programmes for AnGR (ibid.).

2.7 Southwest Pacific

Biotechnologies are not widely used in this region. Six of the 11 Country Reports indicate the use of AI. Out of five countries indicating the species involved in AI programmes, five mention cattle, four pigs, one sheep and one goats. With regard to AI service providers, two Country Reports mention the public sector, two the private sector and one mentions an individual volunteer from a developed country. Several Country Reports from small island states note the potential of AI as a means of introducing exotic germplasm, but the use of the technology appears to be limited. In some countries a small number of private livestock producers are involved in the import of semen for the purposes of AI in their herds. Two Country Reports (CR Australia, 2004; CR Vanuatu, 2003) indicate the use of ET technology, both reports referring to cattle. Additionally, CR Samoa (2004) notes the use of the technology for the introduction of Piedmontese cattle during the 1980s. Capacity for the use of biotechnologies is well developed in Australia, which is the only country from the region reporting the use of molecular techniques to underpin characterization and selection efforts.[10]

[10] New Zealand, a country with a well-developed biotechnology sector, did not submit a Country Report and is, therefore, not included in the analysis.

3 Conclusions

The information provided by the Country Reports unsurprisingly indicates that there is a large gap between developed and developing countries in terms of capacity to utilize biotechnologies in the management and development of AnGR. The focus, particularly in the case of reproductive biotechnologies, is on cattle, and the application of biotechnologies in the use, development or conservation of locally adapted breeds is generally limited. Provision is constrained by a lack of financial, human and technical resources, and problems related to access, affordability and acceptability within diverse local production systems.

In a number of regions, there is increasing diversity in terms of the stakeholders providing services, with greater involvement of the private sector and breeders' organizations. Such developments may have a role in overcoming constraints to the utilization of biotechnologies in developing countries, but it is evident from the Country Reports that progress in this respect is often very limited.

A further concern noted in many Country Reports is the inappropriate use of AI. Concerns largely relate to the unplanned use of the technology to introduce exotic germplasm, which may threaten the existence of indigenous genetic resources. With regard to high-output breeds kept under high external input conditions, there are also some concerns regarding a narrowing of within-breed genetic diversity. The successful application of technologies such as marker assisted selection necessitates high levels of inputs in terms of financial, human and technical resources. As such, the cost-effectiveness of strategies based on the use of such technologies has to be carefully evaluated. Implications for genetic diversity should also be considered. Successful introduction of marker assisted selection will tend favour the utilization of a limited number of breeds at the expense of others, and will also pose a threat to within-breed diversity.

4 References

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SECTION E: LEGISLATION AND REGULATION

1 International legal framework – major instruments

1.1 Introduction

A number of international legal frameworks, relevant to the current and future management of AnGR are described in this section. The frameworks include both legally binding and non-binding instruments. The term "soft law" is used here to refer to non-binding legal instruments, which are utilized for a variety of reasons, including strengthening member commitment to agreements at the policy level, reaffirming international norms, and establishing informal precedents for subsequent treaties.

1.2 Legal framework for the management of biodiversity

This subchapter describes international-level legally binding instruments and soft laws by which national governments undertake to address the management and conservation of biodiversity, to develop policies on the issue, and to implement relevant actions.

Adopted in 1992, Agenda 21 is a plan of action to be undertaken at the global, national and local levels by governments, the organizations of the United Nations System and other stakeholders, to address all areas of human impact on the environment[11]. The Agenda was prepared to coincide with the 1992 United Nations Conference on Environment and Development (Earth Summit) held in Rio de Janeiro, and was adopted at the time by 179 governments. Chapter 14 of Agenda 21, "Promoting Sustainable Agriculture and Rural Development", addresses the question of increasing food production in a sustainable way and enhancing food security. Among the programme areas included in Chapter 14, is programme area (h) on the conservation and sustainable utilization of AnGR. The management-related activities specified in this programme stipulate that governments should: "a) draw up breed conservation plans for endangered populations, including semen/embryo collection and storage, farm-based conservation of indigenous stock and *in situ* conservation, b) plan and initiate breed development strategies, and c) select indigenous populations on the basis of regional importance and genetic uniqueness, for a ten-year programme, followed by selection of an additional cohort of indigenous breeds for development." Subsequently, at the World Summit on Sustainable Development held in Johannesburg in 2002, sustainable agriculture and rural development was one of the issues considered in the Plan of Implementation. Paragraphs 6(i) and 38 of the Final Declaration stress the importance of sustainable agriculture and rural development to the implementation of an integrated approach to increasing food production and enhancing food security and food safety in an environmentally sustainable way.

The Convention on Biological Diversity (CBD)[12], a legally binding international framework for the management of biodiversity, was signed by 150 governments at the Rio Earth Summit. By 2005 it had 188 parties. The three objectives of the CBD, as set out in Article 1, are: the conservation of biological diversity, the sustainable use of components of biological diversity, and the fair and equitable sharing of the benefits arising from the utilization of genetic resources. Conservation of biological diversity clearly encompasses the conservation of the animal and plant genetic resources required for food and agriculture. The CBD states that, while states have the sovereign right to exploit their own resources (Article 3), they also have the duty to conserve them and to facilitate access for sound uses to other Contracting Parties (Article 15). The need for policy development and integration is acknowledged in the CBD, and governments are requested to develop national strategies on biodiversity (Article 6a), and to integrate "the conservation and sustainable use of biological diversity into relevant sectoral and

[11] http://www.un.org/esa/sustdev/documents/agenda21/
[12] http://www.biodev.org

cross-sectoral plans, programmes and policies" (Article 6b). In 2000, the CBD was supplemented by the Cartagena Protocol on Biosafety, which is considered in greater detail below.

The special nature of agricultural biodiversity has been consistently recognized by the Conference of the Parties (COP) to the CBD. Decisions V/5 and II/15 specifically mention "the special nature of agricultural biodiversity, its distinctive features, and problems needing distinctive solutions." Decision V/5 supports FAO's work on AnGR, and states that "Country-driven assessments of genetic resources of importance for food and agriculture ... shall be implemented, including through programmes of FAO." Moreover, the COP's Decision VI/5, "Invite[d] Parties, other Governments, the financial mechanism and funding organizations to provide ... support to enable countries ... to participate fully in the preparatory process for the first Report on the State of World's Animal Genetic Resources, and implement follow-up actions identified through the process."

The Commission on Genetic Resources for Food and Agriculture (CGRFA) was the first permanent intergovernmental forum dealing with agricultural genetic resources. At present, 167 Governments and the European Community are members. Its statutes provide that it shall:

> "have a coordinating role and shall deal with policy, sectorial and cross-sectorial matters related to the conservation and sustainable use of genetic resources of relevance to food and agriculture …
>
> "provide an intergovernmental forum for negotiations and … oversee the development, upon the request of the FAO Governing Bodies, of other international agreements, undertakings, codes of conduct or other instruments relating to genetic resources of relevance to food and agriculture, and … monitor the operation of such instruments …
>
> "facilitate and oversee cooperation between FAO and other international governmental and non-governmental bodies dealing with the conservation and sustainable use of genetic resources, in particular with the Conference of Parties to the Convention on Biological Diversity and the UN Commission on Sustainable Development, and … seek to develop appropriate mechanisms for cooperation and coordination in consultation with such bodies".

The Commission was established in 1983, as the Commission on Plant Genetic Resources, and, in 1995, its mandate was extended to cover all components of biodiversity of relevance to food and agriculture. This mandate is being implemented through a step-by-step approach, and work has so far focused largely on plant and animal genetic resources for food and agriculture. Major achievements of the Commission include:

- the adoption, in 1983, of the International Undertaking on Plant Genetic Resources, a voluntary instrument that was the first international agreement dealing with the conservation and sustainable use of any component of genetic resources. Farmers' Rights were first recognized, in 1989, in the context of the International Undertaking;
- the establishment, in 1994, of the International Network of *Ex situ* Collections of Plant Genetic Resources for Food and Agriculture under the auspices of FAO. This currently provides the legal framework under which the most important collections for food security and sustainable development are held, in trust for the international community, and under the Commission's policy guidance;
- the adoption, in 1996, of the first report on the State of the World's Plant Genetic Resources for Food and Agriculture[13] and of the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture[14];
- the adoption in 2001 of the legally binding International Treaty on Plant Genetic Resources for Food and Agriculture[15] (IT-PGRFA);
- the launch of the preparation process for the State of the World's Animal Genetic Resources for Food and Agriculture including the Strategic Priorities for Action, to be finalized in 2007.

[13] http://www.fao.org/ag/agP/AGPS/Pgrfa/pdf/swrfull.pdf
[14] http://www.fao.org/ag/AGP/AGPS/GpaEN/gpatoc.htm
[15] http://www.fao.org/AG/cgrfa/itpgr.htm

The IT-PGRFA came into force on 29 June 2004, 90 days after 40 governments had ratified it. Article 1 of the Treaty states that "The objectives of this Treaty are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security." Further: "These objectives will be attained by closely linking this Treaty to the Food and Agriculture Organization of the United Nations and to the Convention on Biological Diversity."

1.3 Access and benefit sharing

In the context of AnGR management, it is often the case that livestock breeds or varieties, and the knowledge associated with their management have been developed by local or indigenous communities. Scientific institutions and commercial enterprises may further develop such materials in the same country or elsewhere. In such circumstances, controversies may arise over access to genetic material and the distribution of benefits deriving from its utilization. A number of international frameworks attempt to address the issue.

The CBD recognizes the importance of ensuring "the fair and equitable sharing of the benefits arising out of the utilization of genetic resources". With regard to access, Article 15 of the CBD acknowledges the sovereign rights of states over their natural resources, and states that access is subject to national legislation (Article 15.1). Access is to be granted on mutually agreed terms (Article. 15.4) through bilateral agreements. Prior informed consent of the party providing the genetic resources is required (Article 15.5). The provisions can be taken to mean that the provider of genetic resources must be fully informed in advance by the access-seeking party about the objectives, as well as the economic and environmental implications of such access. The CBD foresees the necessity of legislative, administrative or policy measures to provide for fair and equitable sharing, with the party that provided the resources, the results of research and development and benefits arising from the commercial and other utilization of genetic resources (Article 15.7). A benefit-sharing component is also found in Article 8(j), which contains provisions to encourage the equitable sharing of the benefits arising from the utilization of knowledge, innovations and practices of indigenous and local communities, embodying traditional lifestyles relevant for conservation and sustainable use of biological diversity.

Under the IT-PGRFA, countries agree to establish a multilateral system of access and benefit sharing to facilitate access to plant genetic resources for food and agriculture, and to share the benefits in a fair and equitable way (Article 10). In the case of commercial products that may not be used without restriction by others for further research and breeding, the Treaty provides for a mandatory payment of an equitable share of the resulting benefits. It also identified capacity building, exchange of information and technology transfer as relevant mechanisms for non-monetary benefit sharing. The Treaty recognizes the enormous contribution that farmers and their communities have made and continue to make to the conservation and development of plant genetic resources. "Farmers' Rights" under the Treaty, include the protection of traditional knowledge, and the rights to participate equitably in benefit sharing and in national decision-making about plant genetic resources. The Treaty makes national governments responsible for implementing these rights. The Treaty also foresees a funding strategy to mobilize funds for activities, plans and programmes particularly aimed at helping small farmers in developing countries. This funding strategy also includes the voluntary and mandatory sharing of the monetary benefits paid under the Multilateral System (Article 13) and voluntary payments by Contracting Parties and other stakeholders (Article 18). No similar treaty exists in the case of AnGR.

Falling within the category of "soft laws" are the Bonn Guidelines, which were developed by the CBD and adopted under Decision VI/24. It is, however, evident from the wording of the guidelines that they were drawn up with attention being paid to wild biodiversity rather than AnGR. The guidelines provide a set of voluntary rules which will assist parties, governments and other stakeholders when establishing legislative, administrative or policy measures on access and benefit sharing and/or when negotiating contractual arrangements for access and benefit sharing.

The Bonn Guidelines state that before collecting any genetic resources, a collector should have a written agreement that includes: prior informed consent of the national government of the country of origin; prior informed consent of the indigenous community or communities whose "traditional knowledge" is being accessed; details of the non-monetary and/or monetary benefits the collector will provide; and information on whether, and under what conditions, the collector may transfer the collected genetic resources to another party. The development of mutually agreed terms should be based on the principles of legal certainty and minimization of costs. The Bonn Guidelines set out a detailed description of the type of provisions that could form part of a contractual arrangement. Some of the proposed elements are quite innovative and include specification of the uses for which consent has been granted; the regulation of these uses in light of the ethical concerns of the parties to the agreement; provisions for the continuation of customary uses of genetic resources; possible joint ownership of intellectual property rights according to contributions; confidentiality clauses; and the sharing of benefits from commercial and other utilization of genetic resources including derivatives.

1.4 Legal framework for international trade

The main legal framework regulating international trade in livestock and livestock products is the WTO Agreement on Agriculture adopted in 1994. The basic principles of the WTO[16] agreements include:

- Trade without discrimination – this principle was one of the foundations of the General Agreement on Tariffs and Trade (GATT). In the WTO Agreement, this principle is effected through the operation of various clauses included in the Multilateral Agreements on Trade in Goods, the General Agreement on Trade in Services (GATS), and the Trade-Related Intellectual Property Rights Agreement (TRIPS). The main elements include:
    - Most favoured nation (MFN) clause – requires WTO Members to grant to the products of other contracting parties treatment no less favourable than that accorded to products of any other country.
    - National treatment principle – condemns discrimination between foreign and national goods or services and service suppliers or between foreign and national holders of intellectual property rights.
- Transparency – provisions on notification requirements and the Trade Policy Review Mechanism are set out in the WTO Agreement and its annexes, with the objective of guaranteeing the fullest transparency possible in the trade policies of its Members in goods, services and the protection of intellectual property rights.

Further details relating to the TRIPS Agreement of the WTO are provided below in the discussion of international legal frameworks for intellectual property rights.

Of potential relevance to trade in animal products, and hence to the development of the livestock sector in developing countries, are preferential access regimes to important markets. Such access regimes are permitted, but not required, to be granted to developing countries. An example is the Cotonou Agreement between the African–Caribbean–Pacific (ACP) states and the EU and its Member States. The EU and the ACP States have agreed on a process to establish new trading arrangements to promote trade liberalization between the parties and formulate provisions in trade-related matters. The agreement's Protocol 4 applies to several African countries (Botswana, Kenya, Madagascar, Namibia, Swaziland and Zimbabwe) which are traditional exporters of beef and veal. Within defined quantities of meat per year, set for each country, "customs duties other than *ad valorem* duties applicable to beef and veal … shall be reduced by 92 percent." While arrangements of this nature, can serve to promote export-oriented livestock production in developing countries, trade in animals and animal products is also greatly affected by the WTO Agreement on Sanitary and Phytosanitary Measures (SPS Agreement), which is discussed in greater detail below.

[16] http://www.wto.org

1.5 Intellectual property rights

Rapid developments in the field of biotechnology have increasingly drawn attention to the issue of intellectual property rights in relation to AnGR. The prospect of patents being applied to livestock genes, genetic markers or methods for genetic improvement has given rise to much controversy. The issue potentially has substantial implications for the management of AnGR and access to the benefits arising therefrom (see Section E: 2.1 for further discussion of this issue).

The TRIPS agreement has been in force since January 1995. TRIPS requires WTO members to establish minimum standards for the protection of various forms of intellectual property. The scope of the agreement is broad, applying to copyright and related rights, trademarks, geographical indications, industrial design, patents, the layout designs of integrated circuits, and undisclosed information such as trade secrets and test data. TRIPS requires members to make patents available for any inventions, whether products or processes, in all fields of technology without discrimination, subject to the normal tests of novelty, inventiveness and industrial applicability. Several elements covered by the agreement potentially affect the management of AnGR. While it appears that no patents covering types or breeds of livestock used for food production have been granted, an increasing number of patents relating to genes have been issued. In the event of the introduction of transgenic technologies in animals used for agricultural production, the issue of animal patenting may become more prominent. Article 27.3(b) of TRIPS provides member countries with the option of excluding "plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes" from the basic rule on patentability. There is, therefore, no all-embracing framework covering the issue of patentability with respect to AnGR, and approaches vary from country to country.

Some other elements covered by the TRIPS agreement may have an influence on the management of AnGR. For example, rules related to indications of geographical origin may have an important influence on the ability to market the products obtained from local livestock breeds.

The World Intellectual Property Organization (WIPO)[17] is an intergovernmental organization whose mandate is to ensure that the rights of creators and owners of intellectual property are protected worldwide, and that inventors and authors are recognized and rewarded for their creativity. In a number of policy areas, including agriculture and genetic resources, concerns related to the exploitation of traditional knowledge systems have emerged. In an attempt to address the issue, WIPO's Intergovernmental Committee (IGC) on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore was established in 2000. The committee provides "a forum for international policy debate about the interplay between intellectual property and traditional knowledge, genetic resources and traditional cultural expressions (folklore)". Key questions being addressed by the committee at the time of writing were a possible International Instrument on Intellectual Property in Relation to Genetic Resources and on the Protection of Traditional Knowledge and Folklore, and a possible requirement that patent applications include a disclosure of the source of the genetic material used. The committee has accomplished substantial work on traditional knowledge including a "toolkit" for managing intellectual property when documenting traditional knowledge and genetic resources; a survey of intellectual property protection of traditional knowledge; and a database of intellectual property clauses in bilateral access agreements. WIPO's General Assembly also authorized "the possible development of an international instrument or instruments." However the matter remained contentious, with some South American and African countries favouring swift movement towards an international treaty, and developed countries favouring a more gradual approach.

Another significant development in this field is the Substantive Patent Law Treaty (SPLT), which at the time of writing was under negotiation in the WIPO Standing Committee on the Law of Patents in Geneva. The draft SPLT covers a number of basic legal principles underpinning the granting of patents in different countries, such as the definition of prior art, novelty, inventive step (non-obviousness), industrial applicability (utility), sufficiency of disclosure, and the structure and

[17] http://www.wipo.int

interpretation of claims. The trend is towards upward harmonization of patent law, raising standards much further with little space for national adaptation.

1.6 Legal framework for biosecurity

FAO uses the term "biosecurity" to describe the "the management of biological risks in a comprehensive manner to achieve food safety, protect animal and plant life and health, protect the environment and contribute to its sustainable use" (FAO, 2003). Within the field of biosecurity, a range of laws and regulations have been put in place relating to plant and animal life and health, associated environmental risks, food safety, invasion by alien species, and some aspects of biosafety (Stannard *et al.*, 2004). Several international legal frameworks which affect the management of AnGR focus on issues of biosecurity, and are discussed in the following subchapters. The importance of information exchange at the international level and the establishment of international standards (agreed guidelines, recommendations and procedures) is recognized to be important in facilitating the implementation by developing countries of biosecurity measures (ibid.). FAO has launched an Internet-based International Portal for Food Safety and Animal and Plant Health[18], which serves as a single access point for authorized official international and national information related to biosecurity.

Animal health and food safety

Matters related to animal health are of major international concern, particularly in the context of increasing levels of trade in livestock and livestock products. Governments are keen to ensure that national livestock industries are protected from the potentially devastating effects of transboundary livestock diseases. Serious threats to human health on an international scale, notably outbreaks of HPAI, intensify the need for effective measures at the global level. Marked differences between countries, in terms of their animal health status and standards for food safety, increase the potential for disputes related to international trade. Developing countries in particular tend to be affected by animal health-related trade restrictions. These restrictions can have major impacts on the movement of AnGR (Box 43).

The SPS Agreement of the WTO encourages governments to establish national sanitary and phytosanitary measures consistent with international standards, guidelines and recommendations. International standards are often higher than the national requirements of many countries, including developed countries. The SPS Agreement explicitly permits governments to choose not to use the international standards. However, if the national requirement that differs from the international standards results in a greater restriction of trade, the country imposing the different standard may be asked to provide scientific justification, demonstrating the need for the stricter measure. Countries must establish SPS measures on the basis of a realistic assessment of the risks involved. If requested, counties must make known the factors that were taken into consideration, the assessment procedures used, and the level of risk which was determined to be acceptable. Governments are required to notify other countries of any new or changed SPS requirements that affect trade, and to set up offices (called "Enquiry Points") to respond to requests for more information on new or existing SPS measures. Governments must also open to scrutiny their methods of applying food safety and animal and plant health regulations. As far as animals are concerned, the relevant international standards under the SPS Agreement are those set by the World Organization for Animal Health (OIE) and the FAO/WHO Codex Alimentarius Commission.[19]

The OIE[20] is recognized as the standard-setting body for animal health under the SPS agreement. Health measures contained in the Terrestrial Animal Health Code (in the form of standards, guidelines and recommendations) have been formally adopted by the OIE International Committee. The Terrestrial Animal Health Code is a reference document for use by veterinary authorities, import/export services, epidemiologists and all those involved in international trade. Because of the relationship between animal health and animal welfare, the representatives of the OIE's member

[18] http://www.ipfsaph.org/En/default.jsp
[19] http://www.codexalimentarius.net/web/index_en.jsp
[20] http://www.oie.int

countries have asked the OIE to take the lead role in the setting of international standards for animal welfare. A Permanent Working Group on Animal Welfare was established and held its first meeting in October 2002. In 2005, the International Committee of OIE Member Countries adopted a set of animal welfare standards to be included in the organization's Terrestrial Animal Health Code. The standards cover the transport of animals by land, the transport of animals by sea, the slaughter of animals, and the killing of animals for disease control purposes.

Box 43
Impact of international zoosanitary regulations on animal genetic resources management – the example of FMD

On a global scale, perhaps the most significant transboundary disease in terms of its impacts on trade is foot-and-mouth disease (FMD). Even a limited outbreak of FMD can be devastating for a country's livestock trade. The ability or failure to maintain FMD-free status is likely to have a marked effect on a country's patterns of livestock development. International trade-related rules associated with FMD control may affect the management of AnGR in several ways.

According to OIE rules, a distinction is drawn between disease-free countries where vaccination is practised, and those where vaccination is not practised. To achieve the latter status, and the resulting benefits associated with livestock exports, a country must: have a good record of disease reporting; declare to the OIE that during the past 12 months there has been no outbreak of FMD, no evidence of FMD virus infection, and no vaccination against FMD; have maintained required levels of surveillance; and not have imported any vaccinated animals since the cessation of vaccination.

To meet these requirements, disease-free countries, or those aiming to achieving disease-free status, often combat disease outbreaks with stamping-out or slaughter policies. The mass culling of animals following an outbreak potentially threatens rare-breed populations found in a restricted geographical area. Disease-free countries may also face problems if they require the import of genetic material from countries where FMD is endemic. This can particularly be a problem for tropical countries, as many countries with similar production conditions will be affected by the disease. This point is raised in the Country Report from Trinidad and Tobago (2005). Less direct impacts may relate to differences in the utilization of AnGR between disease-free and disease-endemic countries. Export-oriented producers in the former countries may adapt their production objectives to meet the demands of external markets, and adopt management practices associated with a more commercial outlook. These changes may result in shifts in the balance of breed utilization.

The Codex Alimentarius Commission was created in 1963 by FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. In addition to food standards, the Codex has also addressed safety issues related to animal feed. One of its projects is the preparation of a Code of Practice for Good Animal Feeding, undertaken in response to food trade and health problems arising from animal feed. The Code applies to feed manufacturing and to the use of all feeds, other than those taken while grazing free-range. The primary objective of the Code is to encourage adherence to Good Manufacturing Practices during the production, harvesting, handling, storage, processing (however minimal) and distribution of feed for food-producing animals. A further objective is to encourage good feeding practices on the farm. In recent years, both the Codex Alimentarius and the OIE have also addressed issues related to the safety of genetically modified organisms. These matters will be considered further in the following subchapter on international legal frameworks for biosafety.

Biosafety

Potential for increased output and novel livestock products has stimulated interest in the development of transgenic livestock. The widespread introduction of these technologies would clearly have considerable implications for the management of AnGR. Recombinant DNA technologies are at present applied in the field of veterinary pharmaceuticals. Transgenic crops such as maize are used for animal feed in some countries. A number of environmental and health-related concerns have, however, been raised with regard to genetic modification. Several international frameworks seek to address issues related to the safety of genetically modified organisms (GMOs) or living modified organisms (LMOs) and products derived therefrom.

The Cartagena Protocol on Biosafety was adopted in January 2000 by the Conference of the Parties to the CBD as a supplementary agreement to the CBD, and entered into force on 11 September 2003. The Protocol seeks to protect biological diversity from the potential risks posed by LMOs. The Protocol applies to the transboundary movement, transit, handling and use of all LMOs that may have adverse effects on the conservation and sustainable use of biological diversity, as well as risks to human health. However, LMOs that are pharmaceuticals for human consumption are excluded from the scope of the Protocol if they are covered by another international agreement or arrangement.

The Cartagena Protocol establishes an Advanced Informed Agreement (AIA) procedure in order to ensure that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory (Article 7). However, a number of LMOs are excluded from the AIA procedure because of the specific activity or the intended use of the LMO. The LMOs that may be excluded from the AIA procedure are: LMOs in transit, LMOs destined for contained use, and LMOs intended for direct use as food or feed or for processing. The Protocol reserves the right of countries to take decisions on imports on the basis of the precautionary principle in relation to both LMOs to be introduced into the environment and LMOs to be used for food, feed or processing. Socio-economic considerations arising from the impact of LMOs on biodiversity may also be taken into account in import decisions.

In 1999, the Codex Alimentarius Commission established an Ad Hoc Intergovernmental Task Force on Foods Derived from Biotechnology to consider the health and nutritional implications of such foods. In particular, the objectives of the Task Force are to develop standards, guidelines or recommendations, as appropriate, for foods derived from biotechnology or traits introduced into foods by biotechnology. This is to be done on the basis of scientific evidence, risk analysis and having regard, where appropriate, to other legitimate factors relevant to the health of consumers and the promotion of fair trade practices. An expert consultation on the "Safety Assessment of Foods Derived from Genetically Modified Animals including Fish" was held in November 2003, continuing the work of FAO and WHO on the safety assessment of genetically modified (GM) foods, and focused on GM animals, including fish, and the foods derived therefrom. The main purpose of this consultation was to discuss and describe ways to assess the safety and risk of GM animals. A working paper on the state of the art related to GM farm animals was produced (WHO/FAO, 2003). Environmental and ethical matters related to the production of GM animals/fish were discussed as additional issues.

In May 2005, the OIE International Committee adopted resolutions on genetic engineering applications for livestock and biotechnology products, and the implementation of standards in the framework of the SPS Agreement. Members requested the development of standards and guidelines relating to animal vaccines produced through biotechnology, animal health risks linked to cloning, the exclusion of unapproved animals and products from the livestock population, and genetically engineered animals.

1.7 Conclusions

Animal health-related trade regulations are probably the aspect of international legal frameworks that have the greatest impact on AnGR management at present – affecting both the exchange of genetic material, and the nature of production systems and disease control measures at the national level. The growth of trade in livestock and livestock products, and the associated need to maintain strict animal health standards without imposing unjustified restrictions on trade, has required the establishment of binding international regulations in this field. The increasing significance of international trade has also driven the establishment of international regimes to regulate other aspects of commerce. One area of potential importance to the management of AnGR is that of intellectual property rights. The TRIPS agreement of the WTO, however, allows for the exemption of animals from patenting, and it is national-level legislation, along with regional or bilateral trade agreements which, at present, have the greatest influence in this field.

The recognition that biological diversity is an important resource and aspect of the world's heritage has also motivated the development of legal measures on an international scale – the main instrument being the CBD. Although the distinctive nature of agricultural biodiversity is recognized by the COP

of the CBD, the main focus of the Convention's provisions is on wild biodiversity. There is a concern that legal instruments developed in accordance with the provisions of the CBD, for example in the field of access and benefit sharing, may fail to take sufficient account of the specific problems of AnGR management, and place unnecessary restrictions on exchange and utilization. The IT-PGRFA, established a legally binding international framework specifically for the crop sector, with the objective of ensuring conservation, sustainable use, and equitable sharing of the benefits of genetic resources. There is a need to clarify whether a similar instrument is required for AnGR.

Although many international instruments affect AnGR management, to date, most have paid little or no attention to the topic. Moreover, a number of ongoing and emerging forces are likely to drive further developments in the field of international legislation. Intellectual property rights and issues of access and benefit sharing, for example, may well be issues of increasing significance in coming years; and transboundary livestock diseases are a constant concern. It is vital to ensure that as international law develops, the need for effective and equitable frameworks for the utilization and conservation of AnGR is not overlooked.

1.8 References

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2 Emerging legal issues

This section introduces two policy issues in the field of AnGR management that are increasingly being discussed by stakeholders – patenting and Livestock Keepers' Rights.

2.1 Patenting

General principles and mechanisms

Intellectual property rights (IPRs) are granted in order to provide innovators with a greater opportunity to capture the benefits arising from the products of their inventiveness. The need for IPRs can be justified in economic terms as a means of overcoming a characteristic of market economies which tends to reduce the rate of innovation below the social optimum when innovations can be copied freely. This "market failure" arises as a result of the "public goods" nature of knowledge; the costs of research and development are borne by the innovator, but the benefits accrue to the wider society (Lesser, 2002). Moral arguments in favour of IPRs can also be put forward, related to the justice of rewarding those whose work results in useful innovations (Evans, 2002). However, these two general justifications are seldom tested with empirical data to find whether there is actually a need for stronger IPRs to stimulate research and development in a particular field of innovation.

The discussion below focuses largely on the issue of patents. However, it should be noted that other forms of IPR are of potential relevance to the management of AnGR, particularly trademarks, trade secrets and geographic indications. The holder of a trademark is given exclusive rights to use a name or symbol associated with a product. The goodwill that the holder has built up while providing the product under a given name cannot then be expropriated by others or dissipated through the supply of inferior products under the same name (Lesser, 2002). A relevant example would be Certified Angus Beef ® protected by federal trademark law in the United States of America. Similar to trademarks are rights to geographical appellations of origin, which indicate that a product was produced in a particular geographical area where the production conditions are associated with distinct characteristics. These

rights are of considerable relevance to niche markets, and hence potentially to the utilization of local livestock breeds. In the EU, rules for the use of "geographical indications and designations of origin" are set out in Council Regulation (EEC) No 2081/92.

Trade secrets relate to the protection from misappropriation of any commercially sensitive information (and materials) that the holder takes reasonable precautions to conceal. Crop breeders have for many years used this approach to protect the parent lines and related information used in the production of hybrid seed for sale, and similar approaches are adopted in the poultry and pig industries (Lesser, 2002). Plant breeders' rights (PBRs) (an example of so-called *sui generis* systems) have been developed to protect the IPRs of plant breeders. PBRs offer a protection that is adapted to the agricultural sector, and include certain levels of exemption for further breeding and for farmers to retain seed from the crop. An internationally harmonized framework for the management of PBRs is established under the auspices of UPOV, the International Union for the Protection of New Varieties of Plants. This body was established by the International Convention for the Protection of New Varieties of Plants signed in 1961 which came into force in 1968 and was subsequently revised in 1972, 1978 and 1991; the latter revision coming into force in 1998 (UPOV, 2005).

In the case of patents, the holder is given exclusive rights over the commercial use of an innovation for a set period of time, often 20 years, in the country in which the patent is granted. This competitive advantage serves to counteract the effects of the above-mentioned market failure. In order to obtain a patent, the innovation must be inventive or not obvious; it must be novel, in the sense of not being previously known through public use or publication (Lesser, 2002). A further formal criterion is that the invention must have a practical use; in Europe, the term "industrial application" is used in this context, while in the United States of America, "usefulness" or "utility" is a requirement. A patent can be obtained to cover, a product *per se* (in itself), a process, or a product derived through a process; it may be dependent on previous patents. The requirement for a description of the invention to accompany the application, in such a way that a person "skilled in the art" is able to reproduce it, promotes the dissemination of information and may stimulate research in related fields (ibid.).

While patents may serve to promote innovations, it must be recognized that once a new product has been developed, the existence of a patent inhibits competition and thereby reduces the availability of the product. The balance between the two effects, and hence the outcome in terms of the economic benefits to society as a whole, is a matter of complex interactions between the length and scope of the patent and the nature of demand for the product (Langinier and Moschini, 2002). Moreover, the propensity of patents to promote innovation has sometimes been challenged. Criticisms are advanced on the grounds that access to inputs, or procedures, vital to further innovation may be restricted through the exercise of patents, or that overly broad patents stifle further research in related fields (Evans, 2002; Lesser, 2005).

Patents and living organisms

The extension of patent law to cover plants and animals, or processes related to the production or genetic manipulation of living organisms, gives rise to additional concerns. The idea of asserting ownership over biological processes offends many people's religious or spiritual sensibilities. In this respect, misgivings about patenting are to some extent tied to its association with technologies such as genetic modification. Such concerns are reinforced by fears about the health or environmental impacts of these technologies (Evans, 2002). Other objections to patents on living organisms relate to the belief that natural processes are part of the common heritage of humankind, which should not be alienated for private profit. Similarly, concerns relate to the expropriation of the genetic material developed by local communities, or the associated knowledge of crop/animal breeding activities, through the granting of patents to outside interests (ibid.). Moreover, in the context of food and agriculture, the impacts on food security and social justice of restricting access to animal or plant genetic resources are further causes for concern.

Many of the world's countries do not permit the patenting of plants and animals. However, prominent exceptions include the United States of America and Japan (Blattman *et al.*, 2002). While the EU does not permit the patenting of plant or animal varieties, under Council Directive 98/44/EC of 6 July 1998, it allows patents for inventions concerning animals or plants the feasibility of which "is not confined

to a particular plant or animal variety". Moreover, the fact that the term "variety" is not well-defined in the context of animal breeding means that the scope of the exemption is far from clear (see below for a further discussion of the EU Patent Directive).

Both the 1973 European Patent Convention (EPC), under Article 53(a), and EU Council Directive (98/44/EC) (Article 6), allow for patent applications to be refused if their exploitation is contrary to "ordre public" or "morality". This exemption has been carried over into the TRIPS agreement of the WTO. Unsurprisingly, definitions of "ordre public" or "morality" have not been easy to establish, and the patenting in Europe of the "Harvard oncomouse" (Box 44) has been subject to ongoing legal challenges on the basis of the EPC's "morality exemption" (Thomas and Richards, 2004). More generally, the TRIPS agreement allows countries to exclude plants and animals from patent protection (although there is a requirement for the protection of plant varieties by an effective *sui generis* system). Notwithstanding these exemptions, there is a concern that developing countries' scope to exclude living things from patenting may increasingly be limited by bilateral and regional trade agreements (Correa, 2004).

Box 44
The first patented animal

While patenting has a long history, the inclusion of living things under patent laws is a relatively recent phenomenon. This text box focuses on historical developments in the United States of America related to the applicability of patents to living things and leading to the first case of a patent on a higher animal. Patent law in the United States of America dates back to 1793, but the original statute makes no reference to living things. Indeed, a ruling of 1889 established a precedent indicating that "products of nature" could not be patented. The first provision specifically related to the patenting of living organisms was the Plant Patent Act of 1930, which introduced a specially designed form of protection for asexually reproducing plants (except edible roots and tubers). European countries followed in the next decade with the introduction of their own "*sui generis*" Plant Breeders' Rights laws.

The 1970s and 1980s saw the emergence of technologies that enabled scientists to manipulate the genomes of living organisms. Individuals or organizations undertaking these activities were in a position to claim that the resulting organisms were the products of their own inventiveness rather than simply products of nature. It was not long before the issue was tested in the courts, and in 1980 the case of Diamond vs. Chakrabarty established the precedent that micro-organisms were patentable in the United States of America. The case related to a bacterium engineered to consume oil slicks. Some years later, in 1987, the question of the patentability of higher organisms also came to court. This time, the organism in question was an oyster manipulated to make it more edible. While the application was rejected, the ruling in the case of *Ex Parte* Allen established that there was no legal restriction to the patenting of oysters on the grounds that they are higher animals. In the wake of this ruling the world's first patent on an animal was soon issued. In this case, the animal was a type of mouse developed at Harvard University for use in the study of disease. The mouse had been genetically engineered to make it highly susceptible to cancer. Subsequently, in 1992 the "oncomouse" became the first patented animal in Europe. Not surprisingly, the production of animals deliberately rendered susceptible to a distressing disease provoked widespread public unease, and has served to fuel the controversy surrounding animal patenting.

For further reading see: Kevles (2002); Thomas & Richards (2004)

It was in the fields of medical research and pharmaceuticals that the first legal battles related to granting patents on higher animals were fought out (Box 44). The emergence of animal patenting as a significant issue in the field of food and agriculture has lagged someway behind. Patents on transgenic salmon have been granted in the United States of America (US Patent Number 5,545,808, August 13, 1996) and in the EU (EP 0578 635 B1, July 18, 2001). However, among the species covered by this Report, no examples of patents granted on any breeds or types of animal intended for food production could be found at the time of writing. Nonetheless, as has happened in the biomedical sciences, patenting is emerging as significant issue in the livestock sector, driven in part by technological developments, and the desire to profit from or promote these developments. Once again, ethical objections are raised both regarding patenting as such, and regarding some of the biotechnologies to which it might be applied. It is, however, also important to note that there are numerous practical legal issues that also need to be addressed – particularly related to the scope of patent protection.

Among the factors complicating the application of patenting to farm animals is the tendency of livestock to reproduce, which complicates the process of identifying the animals to which patent rights

should apply (e.g. if patented animals were to be bred with non-patented) (Lesser, 2002). Similarly, long production cycles – particularly in the case of cattle, complicate decisions regarding when in the production cycle patent-related payments should apply (ibid.). The significance of these issues is to an extent dependent on species and production system. The problems are rather less significant in the case of commercial poultry and pig industries, where hybrid lines are provided by large breeding companies, animals are confined, and breeding management is highly controlled. However, even under these production systems, the legal basis for patent claims is debatable. It is not clear that the animals or their breeding methods can be considered non-obvious, or whether the requirement for a description that allows the reproduction of the innovation can be met. A parallel with plant breeders' rights is also difficult to implement in the case of animals, partly because the concepts of plant variety and animal breed differ significantly.

Patent claims related to livestock

Notwithstanding the absence of patents on types of livestock *per se*, patents have been granted on a number of innovations in the field of livestock breeding and genetics. For example, the patenting of biotechnological processes and biological materials derived through such processes is permitted under EU legislation (Council Directive 98/44/EC), even if the material has previously occurred in nature. "Essentially biological processes" consisting "entirely of natural phenomena such as crossing or selection" are exempted (ibid.). However, it is debatable whether any modern breeding technologies involve only "natural phenomena", and the scope of the exemption may therefore be limited.

With regard to the scope of patents on biological materials within the EU, Article 8(1) of the Patent Directive states that "The protection conferred by a patent on a biological material possessing specific characteristics as a result of the invention shall extend to any biological material derived from that biological material through propagation or multiplication in an identical or divergent form and possessing those same characteristics". Similar rules apply to "patent on a process that enables a biological material to be produced possessing specific characteristics" (Article 8(2)). Thus, under EU legislation patent protection is not necessarily limited to an initial process or to the material directly obtained therefrom. Articles 10 and 11 of the Directive place some restrictions on the protection conferred by such patents. In particular, Article 11 indicates that even if breeding stock or genetic material is subject to a patent, a farmer who purchases the material is allowed to use the "animal or other animal reproductive material ... for the purposes of pursuing his agricultural activity" without infringing the patent. However, this does not include sale of the genetic material for the purposes of "commercial reproduction activity". These provisions limit to some extent the potential impact of patenting on AnGR management. However, the border between "agricultural activity" and "commercial reproduction" is not easy to establish. The precise implications of these rules, thus, remain to be tested in practice.

Patents covering genes and markers associated with a range of economically important traits have been granted in several livestock species (Rothschild *et al.*, 2004). There are also patents covering several methods for breeding management and breeding-related computer applications (Schaeffer, 2002). In some cases, the technologies have been successfully commercialized based on these patent rights (Barendse, 2002; Rothschild *et al.*, 2004; Rothschild and Plastow, 2002).

Among the patents granted on breeding-related technologies, it has often been those covering genes or genetic markers (normally as a part of a patented method to enhance the efficiency of selective breeding) that have proved to be controversial. Patenting naturally occurring sequences of genetic material provokes those who are concerned about the implications of patenting "life". Moreover, the granting of a patent which is in some way related to a breed from another country or a breed which has been developed by local communities, may give rise to accusations of "biopiracy". Additionally, the owners of animals naturally carrying the genes in question, or those wishing to utilize the offspring of animals produced by the patented method, may be alarmed about the implications of the patent. The latter issue gave rise to some initial objections within the livestock breeding industry and the research community to the patenting of genetic markers (Rothschild and Plastow, 2002). However, objections from this quarter declined as it became clear that the patents in question did not restrict the utilization of the genes or animals as such, but applied to the methods or processes involving the genes (ibid.).

Applications placed at WIPO by the Monsanto Company for patents on a breeding method and gene sequence in pigs, however, provoked a storm of controversy in 2005. If granted, these patents would include rights over the pigs produced by the patented method and their offspring (WO 2005/017204; WO 2005/015989), and the broad scope of the patent applications has raised fears that the activity of many pig breeders could be affected.

In contrast to the criticisms outlined above, an alternative view is that the extension of patenting offers a feasible means of facilitating beneficial scientific developments. Modern biotechnological innovations generally require considerable investments. In the absence of large amounts of public funding for research and development, it can be argued that the availability of patents serves to stimulate the investments required to enhance the efficiency of livestock breeding (Rothschild and Plastow, 2002; Rothschild *et al.*, 2004). General arguments of this kind related to the impact of patenting on investment, while they may be relevant, are unlikely to answer the concerns of the critics, and it is safe to say that controversy over the issue is unlikely to go away.

Concluding remarks

To conclude, the extension of patenting into the fields of livestock genetics and breeding is rife with controversy and practical difficulties. Factors influencing future trends will include developments in biotechnology, and the political debate regarding the ethics and socio-economic implications of applying patenting to farm animals. As in the medical field, the introduction of GM technologies is potentially a driving force promoting the wider use of patenting in animal breeding. The extension of cloning technology to commercial livestock production could be a further factor encouraging patent applications. However, the use of these biotechnologies in the livestock sector is, in itself, highly controversial. Patents for breeding-related technologies have already been granted in a number of countries, and the commercialization of these technologies will have had some impact upon the management of AnGR, mainly in commercial production systems. Successful applications for broader-scope patents related to breeding methods, or patents which cover the animals *per se* or their offspring, could have considerable implications for commercial producers. Such technologies are of little direct significance in the lower external input production systems where much of the world's livestock genetic diversity is to be found. However, developments in large-scale commercial production systems are not isolated. If wider use of patenting reinforces trends towards greater concentration within, and dominance by, the commercial sector, this would have consequences for the structure of the livestock industry more broadly. Moreover, if the critics' fears are realized, and gene-related patents become widely used to restrict access or demand payments, implications for the utilization of AnGR would be considerable.

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Patent applications at WIPO

(WO 2005/015989) Method for genetic improvement of terminal boars.

(WO 2005/017204) Use of single nucleotide polymorphism in the coding region of the porcine leptin receptor genet to enhance pork production.

2.2 Livestock Keepers' Rights

The prospect of increased exertion of IPRs in the field of animal breeding (see Section E: 2.1) is raising concerns about the continued freedom of livestock keepers to use and develop their own breeding stock and breeding practices. In response to these developments there have been calls by Civil Society Organizations (CSOs) for the establishment of "Livestock Keepers Rights" – initially in allusion to the "Farmers' Rights" that have been enshrined in the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA). In light of intense global exchange of PGR, a legal instrument was considered necessary to facilitate access and ensure benefit sharing. The IT-PGRFA relies strongly on the institutions of the seed sector, which were already heavily involved in the international movement of germplasm.

The situation of exchange in the livestock sector is different from that in PGR. The global movement of live animals is limited by strict sanitary regulations designed to protect the health of national herds, and by the high costs involved. The movement of germplasm is based on commercial agreements and mainly involves international transboundary breeds. Collection and testing of AnGR from the

developing world rarely occur, and it is therefore essential that potential regulations governing access and benefit sharing do not further limit these activities.

The development of legal agreements to define Livestock Keepers' Rights with regard to AnGR and to address international transfers of AnGR was proposed by some NGOs during the World Food Summit in 2002. It is feared that the increased use of IPRs could have negative impacts for both within and between-breed diversity, as well as on the livelihoods of poor livestock keepers. Moreover, it is argued that there is an inherent injustice in the fact that the traditional knowledge that has gone into the development of many local and indigenous breeds, and often forms the foundation and prerequisite for the scientific improvement of breeds, remains unrecognized and unprotected. The objective of any such arrangements should be to ensure rights for those that maintain AnGR without discouraging further characterization, development and utilization.

3 Regulatory frameworks at regional level

3.1 Introduction

Legal frameworks are frequently negotiated in political and regional country groupings to improve cooperation, coordinate activities, and minimize duplication of work. In the field of AnGR management, the EU is the regional grouping with by far the most comprehensive body of legislation, and is the focus of the following discussion. Examining these frameworks gives an indication of how the objectives of the CBD are interpreted and further developed at the regional level, and how different areas of regulation, and their interactions, affect AnGR management. In addition to binding legal frameworks, groups of countries have the option of establishing so-called "soft laws," which may serve to strengthen member country commitment to agreed goals, or act as a model for national-level legislation. One such example is the Model Law drawn up by the African Union (Box 45).

Box 45
The African Union Model Law

The African Model Law for the Protection of the Rights of Local Communities, Farmers and Breeders and for the Regulation of Access to Biological Resources was adopted in 1998 by the Ministerial Session of the African Union. The Model Law was developed to assist Member States deliberate on, formulate, and implement national policies and legal instruments compatible with their national goals and political aspirations, while at the same time satisfying their international obligations. So far, the Model Law has not been adopted by any country.

The Model Law provides a legal framework for the conservation, evaluation and sustainable use of biological resources, and associated knowledge and technologies. In particular, it provides for the rights of local communities, farmers and breeders, over these resources. Although the framework includes agricultural genetic resources, it was developed mainly for plant genetic resources and does not address specific issues related to AnGR in great depth. The Model Law is clear with respect to patents related to forms of life and biological processes, in that such patents are not recognized and cannot be applied for.

Under the Model Law, access to biological resources, community knowledge and technologies, will be subject to the prior informed consent of the state and the affected local communities. Access to biological resources is considered invalid when no such consent has been granted. This is considered to be the case even when permission has been granted but consultation has not taken place, is incomplete, or does not comply with the criteria for genuine and equitable participation. Countries must designate a competent authority to act as the focal point for receiving and processing applications for access. The Model Law recognizes benefit sharing as a right of local communities; the state must guarantee that a specific percentage (minimum 50 percent) of any financial benefit accruing from the utilization of the resources returns to the local community.

With regard to farming communities, this right is reiterated in the section of the Model Law that deals with farmers' rights. Non-financial benefits may include participation in research and development, in order to build capacity; the repatriation of information on the biological resources accessed; and access to the technologies used to study and develop the biological resources. One of the proposed mechanisms for financial benefit sharing by communities in the Model Law is the establishment of a Community Gene Fund. The fund would be established as an autonomous trust and used to finance projects developed by the farming communities.

For further information see: http://www.grain.org/brl_files/oau-model-law-en.pdf

3.2 European Union legislation: an example of a comprehensive regional legal framework

The EU regional framework has been established in the context of economic and political integration among Member States. EU legislation consists of Directives and Regulations, which must be implemented at the Member State level. Directives define the outcomes to be achieved, but leave Member States to decide on the means by which the Directive is transposed into national laws. Regulations are binding in their entirety, and automatically enter into force on a set date in all Member States. The EU has built up a significant body of legislative texts relevant to AnGR management in fields such as conservation, zootechnics (animal breeding), food hygiene, animal health, trade in animals and animal products, organic agriculture, animal feed safety and GMOs.

The Common Agricultural Policy (CAP) is comprised of a set of rules and mechanisms which regulate the production, trade and processing of agricultural products in the EU. The CAP's objectives, as set out in Article 33 of the EC Treaty, are:

- to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilization of the factors of production – in particular labour;
- to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture;
- to stabilize markets;
- to ensure the availability of supplies; and
- to ensure that supplies reach consumers at reasonable prices.

Recent years have seen various moves to reform the CAP. These changes have been partly driven by developments at the international level, notably by agricultural negotiations within the WTO framework. Substantial changes began in 1992; further changes were introduced under the Agenda 2000 policy agreed in 1999. The CAP reform adopted by the Council in June 2003 means that the vast majority of agricultural subsidies will be paid in the form of single farm payments, and are, thus, independent of the volume of production. The new payments are linked to environmental, food safety and animal welfare standards. This shift in policy objectives potentially has significant implications for the utilization of AnGR. Relevant EU legislation in this context included Council Regulation (EEC) No. 2078/92, one of the so-called "accompanying measures" to the 1992 reforms of the CAP, which introduced agri-environment measures intended to promote environmental protection and the conservation of the countryside. This Regulation was subsequently replaced by Council Regulation (EC) No. 1257/99, which in turn is replaced by Council Regulation (EC) No. 1698/2005, which will provide the framework for the work of the new European Agricultural Fund for Rural Development (EAFRD) from 2007 onwards.

More broadly, EU policy aims to promote sustainable and integrated rural development, and to encourage the participation of local stakeholders in the development process. To this end, Council Regulation (EC) No. 1257/1999 "on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF)" established the framework for support for sustainable rural development, including protection of the environment. The CAP also seeks to promote economic and social cohesion, by encouraging the development of new activities and sources of employment. In this context, the LEADER+ initiative (described in Commission Notice 2000/C 139/05) has been established to encourage rural stakeholders to consider the longer-term potential of their area, and to develop new ways of enhancing its natural and cultural heritage. This is intended to reinforce economic development and job creation, and to improve the organizational capabilities of rural communities.

Management of genetic resources

This subchapter discusses legislation directly related to the management of AnGR – the legal framework for conservation and animal breeding. In the field of conservation, Commission Regulation (EC) No. 817/2004 provides for financial support to be given to farmers rearing farm animals of "local breeds indigenous to the area and in danger of being lost to farming" under the framework of Regulation 1257/1999 (see above). The breeds in question must contribute to the maintenance of the local environment. Threshold population sizes, determining the eligibility of local breeds (of cattle, sheep, goats, pigs, equines or poultry) for inclusion in the scheme are set out in Commission Regulation (EC) No. 817/2004. Population thresholds (number of breeding females) below which a breed is considered to be endangered for the purposes of incentive payments are set out. The figures are based on the number, summed across all Member States, of breeding females available for pure-bred reproduction, included in a register (e.g. herd book or flock book) recognized by a Member State. The thresholds are 7 500 for cattle, 10 000 for sheep, 10 000 for goats, 5 000 for equidae, 15 000 for pigs and 25 000 for avian species. Opportunities to support conservation measures are to be further strengthened from 2007 onwards under Commission Regulation (EC) No. 1698/2005. The objective is to compensate farmers who provide environmental services for the "additional costs and income foregone … [and where necessary] ... may cover also transaction cost" (Article 39:4). The Regulation specifies that payments can be made for the "conservation of genetic resources in agriculture" (Article 39:5). The Regulation provides for the adoption of strategic guidelines for rural development at the Community level for the period 2007 to 20013, and requires that Member Countries establish national strategy plans setting out details of agri-environmental payments. A further Regulation, intended to replace Commission Regulation (EC) No. 817/2004, was in preparation at the time of writing.

Some concerns have, however, been raised regarding the effectiveness of incentive payment schemes under Regulations 1257/1999 and 817/2004, in that payments to farmers did not take into account differences between breeds in terms of their extinction probabilities, and that subsidy payments were frequently insufficient to compensate farmers for the losses involved in keeping the local breeds

(Signorello and Pappalardo, 2003[21]). Only around 40 percent of breeds classified as at risk by FAO were covered by the payment schemes established under these Regulations, and in some countries no schemes existed (ibid.).

The EU is a party to the CBD and, as a consequence, all EU countries are obliged to develop national biodiversity strategies which, in the context of agricultural biodiversity, address conservation of AnGR. *In situ* conservation is regarded as the preferable approach, as it enables utilization and further characterization of AnGR. At the regional level, the Biodiversity Action Plan for Agriculture[22] was adopted in 2001. The CAP instruments, as shaped by Agenda 2000 and subsequent reforms, provide the framework for integrating biodiversity concerns into EU agricultural policy. The priorities of the Action Plan are: the promotion and support of environmentally friendly farming practices and systems that benefit biodiversity; the support of sustainable farming activities in biodiversity-rich areas; the maintenance and enhancement of good ecological infrastructures; and the promotion of actions to conserve local or threatened livestock breeds or plant varieties. All these priorities are supported by research, training and education. Biodiversity conservation greatly depends on the appropriate application of measures within the CAP, notably compensatory allowances for less favoured areas, and agri-environmental measures.

A Regulation, related to the implementation of the Action Plan, is Council Regulation (EC) No. 870/2004. This Regulation explicitly aims to increase the emphasis on the conservation of AnGR. There was a concern that under previous legislation in the field, such as Council Regulation (EC) No. 1467/94, livestock received less attention than crops. “Targeted actions”, under Article 5, of Regulation 870/2004 include: the promotion of characterization, collection, utilization and *ex situ* and *in situ* conservation of genetic resources; the establishment of a Web-based inventory of genetic resources included in conservation programmes, and of *in situ* and *ex situ* conservation facilities; and the promotion of the exchange of relevant scientific and technical information. For AnGR kept on farms, the focus is to be on a network of inventories of administrative aspects (funding, endangerment status of breeds, location of herd books etc.). Transnational “concerted actions”, under Article 6, will promote information exchange to improve the coordination of actions and programmes for the management of genetic resources in Community agriculture. “Accompanying actions”, under Article 7, will cover the dissemination of information and advice to stakeholders such as NGOs; the provision of training courses; and the preparation of technical reports. Proposals for actions may be put forward by stakeholders such as genebanks, NGOs, breeders, technical institutes and experimental farms.

Areas related to AnGR eligible for funding under the Regulation include: the development of standardized criteria to identify priorities in the field AnGR management; the establishment of European genebanks based on national or institutional genebanks; the characterization and evaluation of AnGR; the establishment of a standardized performance testing regime for AnGR, and documentation of characteristics of endangered breeds; the establishment and coordination of a European-wide network of "Ark farms", rescue-stations and parks for endangered breeds; the development of cross-national breeding programmes for endangered breeds and the establishment of rules for the exchange of information, genetic material and breeding animals; the development of strategies to promote linkages between local breeds and niche markets, environmental management and tourism; and the development of strategies which promote the use and development of underutilized AnGR that could be of interest on a European level. It should, however, be noted that Council Regulation (EC) No. 870/2004 only allows for joint actions involving several countries, and, therefore, its value to the implementation of national measures as part of national action plans is limited. The new Commission Regulation (EC) 1698/2005 will be an improvement in this respect.

A further body of EU legislation relates to the management of livestock breeding. The efficient management of AnGR is dependent on the availability of trustworthy information relating to animals’ pedigrees and performance data. Reliable mechanisms must be in place for animal identification,

[21] Signorello, G. & Pappalardo, G. 2003. Domestic animal biodiversity conservation: a case study of rural development plans in the European Union. *Ecological Economics*, 45(3): 487–499.

[22] Communication from the Commission to the Council and the European Parliament Biodiversity Action Plan for Agriculture. Commission of the European Communities, Brussels, 27.3.2001. http://europa.eu.int/comm/agriculture/envir/biodiv/162_en.pdf.

recording, and the definition of breeding objectives. An effective legal framework covering livestock breeding activities is, therefore, required. A number of laws have been put in place to regulate intra-Community trade of pure-bred breeding animals. The legislation covers bovine, porcine, ovine, caprine and equine animals. Poultry and rabbits, although they are important commercial species, are not covered. For bovine animals, Council Directives 77/504/EEC and 87/328/EEC require that Member States do not allow restriction, on zootechnical grounds, of trade with other Member States in pure-bred breeding animals, semen, ova or embryos. Countries must enable the establishment of herd-books and breeders' organizations, and not prevent the entry in their herd books of pure-bred animals from other Member States. EU legislation defines a pure-bred animal as an "animal the parents and grandparents of which are entered or registered in a herd-book of the same breed, and which is itself either entered or registered and eligible for entry in such a herd-book."

Detailed rules are set out for bovine animals in Commission Decision 84/247/EEC, covering the recognition of breeders' organizations; Commission Decision 84/419/EEC, covering the keeping of herd books; Commission Decision 2005/379/EC, covering pedigree certificates; Commission Decision 86/130/EEC, covering performance testing and genetic evaluation; and Council Directive 87/328/EEC, covering acceptance of animals for breeding. The latter Directive is of considerable importance in terms of liberalization and reducing trade barriers in cattle breeding. Similar sets of rules are in place for other species/classes of livestock. In the case of hybrid pigs (but not breeding programmes for pure-bred animals), private undertakings can be approved to maintain breed registers (Commission Decision 89/504/EEC). With regard to bovines, Council Decision 96/463/EC establishes the INTERBULL Centre in Uppsala Sweden as the reference body for uniform testing and genetic evaluation for pure-bred animals. In the case of equidae, Commission Decision 93/623/EEC sets out provisions relating to identification documents (passports) for animals registered in stud books (legislation related to animal identification is discussed further in the subchapter on animal health below).

Several points arise from this body of breeding-related legislation: breeders' associations are state-approved, and as such are mandated to keep herd books for pure-bred animals, and to perform breeding programmes including conservation breeding programmes. Provided certain conditions related to the organization's capacities and its rules are met, breeders' associations have to be approved. Any group of breeders can set up a new breeding organization for an existing breed, unless it is considered that a partition of the population would endanger the conservation of the breed or jeopardize the zootechnical programme of an existing organization. As such, an existing breeding organization has no property right on the basis of which it can exclusively breed the breed in question. In the case of equines, some additional legal privilege is given to breeders' organizations which maintain the "stud-book of the origin of the breed", as it can set rules that must be followed by newly established "filial stud-books".

Specialized food products and organic agriculture

Niche markets for distinctive livestock products are recognized as being potentially important to the economic viability of many local breeds. EU legislation provides for a number of schemes under which distinctive products can be registered so that producers are protected against imitation and can take advantage of the higher prices that consumers are willing to pay. One aspect of these schemes relates to the association of a product with a distinct geographical area. Council Regulation (EEC) No. 2081/92 states that to qualify for a protected "designation of origin" a foodstuff must have "quality or characteristics ... which are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors, and the production, processing and preparation of which take place in the defined geographical area". Similar, but less narrowly defined, criteria are set out for the registration of a "geographical indication". Under Article 4 of the Regulation, requirements for product specification are outlined. Among the requirements are a name and description of the product; definition of the geographical area involved; evidence regarding the origin of the product and its links to the local area; an outline of methods used to obtain the product; a description of inspection structures; and details of labelling. Although not always the case, some product specifications prepared under these rules indicate that products or the raw materials used in their manufacture are to be sourced from specific livestock breeds. Even where a breed is not specified, the marketing of

specialized local products may promote the survival of traditional management systems in the specified locations and thereby support the continued utilization of well-adapted local breeds.

In a similar manner, Council Regulation (EC) No. 2082/92 sets out the rules whereby a "certificate of specific character" can be obtained for a foodstuff or product. The Regulation allows for the registration of distinguishing features that are not a matter of provenance or geographical origin and that do not relate solely to the application of a technological innovation. In order to appear in the register of certificates of specific character set up by the Commission a product or foodstuff "must either be produced using traditional raw materials or be characterized by a traditional composition or a mode of production and/or processing reflecting a traditional type of production and/or processing". Once again, the promotion of diverse products of this kind potentially has positive implications for the genetic diversity of livestock populations. Some EU countries actively promote and provide support for a wider use of "certificates of specific character" as a means to valorize, and thereby protect, rare breeds.

The management of AnGR may also be affected by EU legislation related to organic agriculture. This legislation aims to establish a harmonized framework for the production, labelling and inspection of products, in order to increase consumer confidence and ensure fair competition between producers. Council Regulation (EEC) No. 2092/91 establishes a framework for the labelling, production and control of agricultural products bearing or intended to bear indications referring to organic production methods. Regulation (EEC) No. 2092/91, however, did not include any standards for livestock and was, therefore, supplemented by Regulation (EC) No. 1804/1999.

The latter Regulation sets out detailed rules covering conversion to organic farming, the origin of the animals, feed, disease prevention and veterinary treatment, husbandry practices, transport, identification of livestock products, utilization of manure, free range areas and housing (animals must, providing conditions allow, have access to open-air grazing or exercise areas), stocking densities, and overgrazing. The Regulations cover bovine, porcine, ovine, caprine, equine and poultry species. Separate rules are set out for bees. With regard to the origin of the animals, the rules state that:

> "In the choice of breeds or strains, account must be taken of the capacity of animals to adapt to local conditions; their vitality, and their resistance to disease. In addition, breeds or strains of animals shall be selected to avoid specific diseases or health problems associated with some breeds or strains used in intensive production (e.g. porcine stress syndrome, PSE syndrome, sudden death, spontaneous abortion, difficult births requiring caesarean operations, etc.). Preference is to be given to indigenous breeds and strains."

The rules further specify that the first principle to be applied in the prevention and control of disease is the choice of appropriate livestock breeds; the use of veterinary pharmaceuticals is highly restricted. As such, adaptations required of livestock kept under organic systems are often quite different to those required under non-organic systems, most notably in terms of animal health and housing conditions. While much organic livestock production makes use of conventional high-output breeds, there is considerable potential for the utilization of rarer, locally adapted breeds.

In 2004 the European Action Plan for Organic Food and Farming[23] was adopted with a view to ensuring a further development of the organic sector in the coming years and to providing an overall strategic vision for organic farming's contribution to the CAP. One of the actions was to render the public benefits of organic farming explicit by defining its objectives and basic principles. To this end EU Member States were, at the time of writing, negotiating a proposal for a new legal framework which will eventually replace Council Regulation (EEC) No. 2092/91. With regard to biodiversity, the proposed objectives state that "The organic production system shall maintain and enhance a high level of biological diversity on farms and their surrounding areas."[24]

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[23] Communication from the Commission to the Council and the European Parliament European Action Plan for Organic Food and Farming. Commission of the European Communities, Brussels, 10.06.2004 COM(2004)415 final. http://europa.eu.int/comm/agriculture/qual/organic/plan/comm_en.pdf

[24] Proposal for a Council Regulation amending Regulation (EEC) No 2092/91 on organic production of agricultural products and indications referring thereto in agricultural products and foodstuffs.

Animal health

The EU has a body of legislation aimed at improving animal health within the Community, while permitting intra-Community trade and imports of animals and animal products in accordance with health standards and obligations under international law. Specific sets of laws apply to bovines, ovines and caprines, equines, porcines, poultry and hatching eggs, as well as aquaculture, pets and non-commercial animals, and other live animals. A distinction is drawn between imports and intra-Community trade – in many respects, separate legal frameworks apply to each. Preventive health measures cover live animals, semen and embryos, and animal products.

Restrictions on the movement of genetic material have the potential to constrain the activities of livestock breeders in EU Member States. Moreover, animal health-related restrictions on imports of animals, germplasm and animal products to the markets of the EU will, in some cases, limit the development of export-oriented livestock production in countries which are not members of the EU, and hence affect decisions regarding the utilization of AnGR in these countries.

For intra-Community trade in bovines and porcines, rules are set out in Council Directive 64/432/EEC and subsequent amendments. Rules are laid down relating to measures required to prevent the spread of disease during the transport of animals; diagnostic tests for specific diseases; animal identification to ensure traceability; and the harmonization of veterinary health certification. With regard to imports, bovines and porcines imported from non-member countries must comply with the standards stipulated in Council Directive 72/462/EEC. Standards which must be met by the exporting country are set out, covering the state of legislation; the health status of livestock and other animals; the state of disease reporting to the OIE; standards for the production, processing and transit of animal products; disease control measures, and the state of national veterinary services. Conditions also stipulate that the exporting country must be free of specific livestock diseases. Standards must be verified by the European Commission's Food and Veterinary Office. Once this verification is completed the exporting country can be included, under Council Decision 79/542/EEC, in a list of third countries from which the Member States authorize imports. Rules covering certification for import, and veterinary border inspection posts for live animals are set out in Council Decision 79/542/EEC and Council Directive 91/496/EEC, respectively. Similar legislation is in place covering other animal species.

Intra-Community trade and imports of bovine semen and embryos are regulated by Council Directive 88/407/EEC and Council Directive 89/556/EEC, respectively. The Directives set out health standards that semen and embryos must meet in order to be imported or traded within the EU, and conditions required for the approval of semen collection and storage centres. Lists of approved countries for the importation of semen and embryos and approved centres are drawn up. Rules are also set out covering the health certification of traded semen and embryos. Similar rules are in place for other livestock species. Council Directive 88/407/EEC was subsequently amended by Council Directive 2003/43/EC, which allows semen storage centres in addition to semen collection centres (having their own bulls) to engage in trade in bovine semen between Member States – a significant step towards the liberalization of this market.

The objectives of these Directives are to regulate intra-Community trade and import of semen, rather than to facilitate the cryoconservation of genetic material. Indeed, the legislation may present problems with regard to obtaining semen from endangered breeds for conservation purposes. Collecting semen at an AI centre is costly compared to on-farm collection, and collecting semen from rare breeds is usually not of commercial interest to the AI industry. A further issue relates to the long-term storage of genetic material for conservation purposes. Material collected in the past inevitably fails to conform to current standards. The dissemination of the material to breeders, therefore, becomes legally problematic. This is particularly the case for exchange of genetic material between Member States. However, in some countries, the rules set out in the Directives, when incorporated into national legislation, are applied not only to semen destined for intra-Community exchange, but also to semen used at the national level.

Trade in fresh meat is regulated by Council Directive 2002/99/EC. The objective is to ensure harmonization of health-related requirements across all Member States, and to prevent the entry into

the EU of products that may be carrying infectious diseases dangerous to animals or humans. Conditions relating to animal health status are set out for importing countries. The conditions are similar to those for live animals, but include the requirement that meat comes from an approved establishment (slaughterhouse etc.). Additional guarantees may be required in response to specific disease problems, such as the deboning and maturation of meat from animals vaccinated against FMD. It is also possible that a third country may only be permitted to export meat from certain categories of animals to the EU. Further rules relate to chemical residues, BSE (bovine spongiform encephalopathy) and animal welfare at the time of slaughter. Separate legislative frameworks are in place for meat products, poultry, milk and milk products, and for other categories such as game meat.

In addition to the trade-related laws outlined above, the EU has a body of laws dealing with the prevention, control, monitoring and eradication of specific diseases. Separate Directives cover African horse sickness (Council Directive 92/35/EEC), African swine fever (ASF) (Council Directive 2002/60/EC), FMD (Council Directive 2003/85/EC), avian influenza (Council Directive 2005/94/EC), bluetongue (Council Directive 2000/75/EC), classical swine fever (CSF) (Council Directive 2001/89/EEC), Newcastle disease (Council Directive 92/66/EEC), and certain diseases of fish and molluscs. A further Directive (Council Directive 92/119/EEC) covers a number of other exotic livestock diseases. Eradication and monitoring programmes aim to progressively eliminate diseases that are endemic in parts of the EU. Council Decision 90/424/EEC relates to the provision of funding for such programmes, and Council Decision 90/638/EEC sets out criteria which have to be met in their preparation. Disease control measures may specify restrictions on livestock movement in the case of an outbreak, requirements for vaccination or vector control, or in the case of certain serious diseases, require the culling of infected and in-contact herd/flocks. The latter action potentially has serious consequences for rare-breed populations located in the affected areas.

In recognition of the threat posed by culling measures, provisions for the exemption of rare breeds are included in Directives related to several diseases. For example, Council Directive 2003/85/EC, which relates to FMD, allows (under Article 15) for the derogation of the requirement for immediate slaughter of affected herds/flocks in the case of "a laboratory, zoo, wildlife park, and fenced area or in bodies, institutes or centres approved in accordance with Article 13(2) of Council Directive 92/65/EEC and where animals are kept for scientific purposes or purposes related to conservation of species or farm animal genetic resources" becoming infected with the disease. A list of premises that are identified as a "breeding nucleus of animals of susceptible species indispensable for the survival of a breed" must be established in advance (Article 77). The Commission must be notified in the event of a Member State deciding to derogate slaughter measures, and it must be ensured that "the animal health status of other Member States, are not endangered and that all necessary measures are in place to prevent any risk of spreading foot-and-mouth disease virus."

Similarly, Directive 2005/94/EC relating to avian influenza, allows for derogation of slaughter measures the case of "an outbreak of HPAI in a non-commercial holding, a circus, a zoo, a pet bird shop, a wild life park, a fenced area where poultry or other captive birds are kept for scientific purposes or purposes related to the conservation of endangered species or officially registered rare breeds of poultry or other captive birds, provided that such derogations do not endanger disease control" (Article 13). Requirements relating to the confinement and restrictions on the movement of birds covered by such derogations are set out in Article 14. The Directives relating to CSF and ASF also allow for exemptions for rare-breed populations if specified conditions are met. It should, however, be noted that similar provisions, designed to protect rare genetic resources, are not included under older Directives relating to other serious livestock diseases (e.g. Newcastle disease and African horse sickness).

As discussed in Part 1 – Section F: 4, measures outlined in Commission Decision 2003/100/EC on breeding programmes for the elimination of scrapie have also raised concerns. Rare sheep breeds that lack or have low frequency of the resistant genotypes may be threatened. Participation in breeding schemes will be compulsory for flocks of "high genetic merit", and will result in the castration or slaughter of rams carrying the "VRQ" allele associated with susceptibility to the disease. The Decision does, however, allow for derogations of these requirements in the case of breeds which have low frequencies of the resistant ARR allele and which are in danger of being lost to farming.

The implementation of animal health-related rules is backed up by a body of legislation on animal identification. These laws are also relevant to food safety and traceability, management and supervision of livestock premiums, and to the certification of animals for breeding purposes. In the case of bovine animals, for example, rules are set out in Regulation (EC) 1760/2000. The identification system for bovines comprises ear tags for individual animals, computerized databases, animal passports and individual registers kept on each holding.

The identification requirements (specifically ear tagging) present practical problems with respect to the keeping of animals for certain specific purposes or under some management conditions. There could, thus, be implications for particular AnGR normally kept in such circumstances. Some steps have been taken to adapt legal measures in order to address these problems. In the case of bovine animals kept for cultural and historical purposes on approved premises, provisions are made under Commission Regulation (EC) No. 644/2005 for alternative means of identification. There are also separate rules for bulls kept for sporting or cultural purposes (Commission Regulation (EC) No. 2680/1999); and in the case of cattle kept on nature reserves in the Netherlands for landscape and conservation purposes, the maximum period for the application of ear tags (normally 20 days after birth) can be extended up to 12 months (Commission Decision 2004/764/EC). Similarly in Spain, an extension of up to six months was permitted, under Commission Decision 98/589/EC, for animals of certain breeds, kept under extensive conditions in specified geographical regions. The specific provisions for Spain were subsequently repealed when a more general provision was introduced (Commission Decision 2006/28/EC) covering all Member States. The rules allow extensions of up to six months for holdings where cattle are kept under extensive conditions, where ear tagging presents practical problems because of geographical conditions and the animals are unused to handling, and provided the calves can be clearly assigned to their mothers at the time of tagging.

Animal welfare

Council Directive 98/58/EC sets out rules protecting the welfare of farmed animals. Further Directives deal specifically with laying hens, calves and pigs. The legislation outlines standards for veterinary care; freedom of movement for animals in accordance with their physiological and behavioural needs; shelter, cleanliness, ventilation and lighting in buildings and accommodation; provision of feed and water; mutilations and breeding procedures; as well as staffing levels, inspection of animals, and record keeping. With specific regard to animal breeding, the Directive states that “natural or artificial breeding procedures which cause, or are likely to cause, suffering or injury to any of the animals concerned shall not be practised”, and that “no animal shall be kept for farming purposes unless it can reasonably be expected, on the basis of their genotype or phenotype, that they can be kept without detrimental effect on their health and welfare.”

Council Regulation (EC) No. 1/2005 provides for the protection of animals during transport. The Regulation radically overhauls existing EU rules on animal transport. Salient features include new rules to cover the treatment of animals before and after transportation at locations such as farms, markets, slaughterhouses and harbours; training and certification of drivers; improved enforcement, including tracking of vehicles by satellite navigation systems; stricter standards for journeys over eight hours – including improved standards for lorries; and stricter standards for the movement of young and pregnant animals. Council Directive 93/119/EEC relates to the minimizing the pain and suffering undergone by animals at the time of slaughter. The regulations cover the equipping of slaughterhouses; the competence of slaughter house staff; and specify that animals must be stunned before slaughter or killed instantaneously.

Food safety

EU legislation related to food safety has in recent years undergone significant reform. Legislative and other actions have been developed, to ensure compliance with EU food safety standards in Member States; to manage international relations with non-member countries and international organizations concerning food safety; to manage relations with the European Food Safety Authority (EFSA); and to ensure science-based risk management. The central element of legislation in this field is Regulation (EC) No. 178/2002.

Food safety measures may have negative implications for the production of specialized foodstuffs such as cheeses made with raw milk from local breeds, and thereby undermine the potential contribution of niche markets to breed conservation. Concerns about food safety are also a driving force behind legislation aimed at the eradication of scrapie. As described above and Part 1 – Section F: 4, these measures pose a threat some rare breeds of sheep. A further outcome is that many developing countries are concerned that they are unable meet increasingly complex and burdensome EU standards and regulations. Indeed, environmental, and SPS measures are considered by a number of countries to be a greater constraint to exports to the EU than are tariffs and quantitative restrictions. The EU legislative framework for food safety, thus, affects livestock production and marketing, and, hence, the utilization of AnGR, both within the EU and elsewhere in the world.

The production, marketing and utilization of livestock feed is also covered by EU legislation. Developments in this field are increasingly driven by concerns about human and animal health. These laws do not directly impact the management of AnGR, but form a part of the framework within which livestock producers have to operate and take decisions regarding their management practices. Regulation (EC) No. 882/2004 sets out rules designed to ensure that impacts on feed and food safety are considered at all stages in the process of feed production and utilization. With regard to the inclusion of GMOs in livestock feed, Regulation (EC) No. 1829/2003 covers applications for the placing on the market of GMOs, and products containing or derived from GMOs. The labelling and traceability of such products is covered by Regulation (EC) No. 1830/2003.

3.3 Conclusions

Many regulatory aspects of AnGR management would benefit from regional or subregional coordination. Regional transboundary breeds are found in substantial numbers in most regions of the world, and thus conservation measures should be planned at subregional or regional level. Trade in livestock products can be promoted by common standards guaranteeing quality and safety. Breed improvement is facilitated if a common framework for registration and genetic evaluation is put in place.

The EU provides an example of a comprehensive set of regional regulations affecting AnGR management. Legislation promoting conservation measures has been in place for some years, and has recently been strengthened. Incentive payments for breed conservation appear to fit well with the need to find alternatives to production-related subsidies. However, the evidence suggests that schemes have not always been sufficiently well targeted to effectively promote the conservation of some of the most endangered breeds. The overall focus of the EU legislative framework is less on conservation than on providing an enabling environment for breed improvement, promoting free trade in breeding material among Member States, and ensuring an effective regime for the control of livestock diseases. Unsurprisingly, regulations promoting these objectives have at times clashed with conservation goals. It is, however, interesting to note that in some such cases the problems have been recognized, and relevant adaptations to the legislative framework implemented.

3.4 Legislation cited

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COUNCIL REGULATION (EC) No 1/2005 of 22 December 2004 on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation (EC) No 1255/97. http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/oj/2005/l_003/l_00320050105en00010044.pdf

COUNCIL REGULATION (EC) 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/oj/2005/l_277/l_27720051021en00010040.pdf

COMMISSION NOTICE TO THE MEMBER STATES 2000/C 139/05of 14 April 2000 laying down guidelines for the Community initiative for rural development (Leader+) http://europa.eu.int/eur-lex/pri/en/oj/dat/2000/c_139/c_13920000518en00050013.pdf

4 National legislation and policy

4.1 Introduction

Functioning legal frameworks, or at minimum, clear policies and programmes, are prerequisites for effective management of AnGR. Clear legislation, and the security which it provides, is important both for economic activities such as international and domestic trade, and for the definition of the competences, rights and duties of the stakeholders involved in AnGR management.

From a country-level perspective, the effectiveness of a legal framework can be assessed on the basis of the extent to which it promotes or hinders the achievement of the country's agricultural development goals. These goals are manifold and trade-offs between them are often necessary. National-level goals may include ensuring food security and food safety, promoting national economic growth, enhancing the income and livelihoods of the rural population, preventing the degradation of the natural environment, or maintaining biological diversity. Countries are also very diverse in terms of their ecological, cultural and political environments. This section describes both general frameworks and specific solutions that have been developed in the field of legislation and policy. It aims to highlight difficulties and gaps in existing provisions, and to facilitate the exchange of ideas, solutions and experiences.

4.2 Methods

The analysis draws on information from the following sources:

- the Country Reports submitted as part of the SoW-AnGR preparation process, supplemented in some cases by e-mail correspondence with the NCs;
- an earlier survey carried in 2003 by out by FAO's Development Law Service; and
- additional information found in FAO's legal data bank (FAOLEX[25]).

The starting point for the analysis was a broad definition of both "management of AnGR" and "legal framework". The former term was taken to encompass conservation of AnGR (including the indirect effects of sustaining the production systems where the genetic resources are utilized); genetic improvement (including regulation of specific techniques and the associated infrastructure); and animal health (including provisions related to trade, breeding and transport). Supporting factors, such as institutional structures and incentive measures were also taken into account.

For the purposes of the analysis, "legal framework" was taken to include all types of legislation reported as being relevant to AnGR management. Additionally, as many countries mentioned policies and strategies or similar instruments for the management of AnGR, these instruments were taken into consideration, even if in many instances the legal basis for their implementation was not clear.

The descriptions provided by the Country Reports present a differentiated picture, which cannot be fully represented here. The objective of the following discussion is, therefore, to offer an overview of the subject and to describe general patterns and models. Examples drawn from the Country Reports are included to illustrate typical cases or those that are particularly useful or creative. Region-specific statistical overviews are presented where this illustrates particular points of interest. However, it should be noted that not all Country Reports present the same degree of detail in their discussion of legal frameworks. The statistics presented should not, therefore, be taken to represent a complete picture of the state of legal provision, but rather as broad indicators of regional capacities with respect to AnGR-related laws and policies.

[25] http://faolex.fao.org/faolex/

4.3 Implementation of AnGR legislation and programmes

Management, sustainable use and conservation of AnGR may involve the mandates of different public agencies, and involve a great variety of private actors – from farmers and breeders, to food processing and marketing enterprises. It entails a great amount of knowledge (both traditional and related to modern biotechnologies). The creation and implementation of legislation is a multifaceted task, requiring a high degree of coordination and organization.

Legal frameworks are, clearly, not the only option for achieving policy goals. An important question to be considered is the relative efficiency of legal means (often requiring expensive control measures) as compared to other policy measures (creating incentives and supporting mechanisms of various kinds, and removing distortions or disincentives). Thus, the following thematic sections describe examples of both legislative and policy measures.

Institutional Framework

Institutions that have a clear mandate and that function well are the backbone of the implementation of laws and policies. A basic institutional structure is essential for the coordination of strategies for AnGR management. Clear legal definitions of institutional roles are important. Complicated or unclear arrangements may cause problems for coordination and communication between stakeholders.

Institutional mechanisms for the implementation of AnGR-related laws are diverse. Frameworks vary between countries according to the characteristics of national administrative systems, the availability of financial resources, and the overall economic and social conditions. Two main approaches to institutional development can be discerned: 1) the establishment of *ad hoc* bodies to meet particular needs; and 2) the optimal use of existing institutions with possible adjustment of their mandates or structures (FAO, 2005).

A great variety of institutions are reported to have a role in AnGR management. However, as a rule, AnGR management at the national level is the responsibility of the Ministry of Agriculture; health-related issues may be the responsibility of the Ministry of Health, other Ministries such as Trade or Environment may also play a role. The discussion presented below focuses only on the specific institutions involved (i.e. not the "basic" ministries). These may include government agencies, private organizations to which tasks are delegated, or mixed public–private ventures. Competences and duties of such institutions (or at least of higher-level bodies) ought to be defined by law. The legal mechanisms involved are, not always clear from the information contained in the Country Reports. However, wherever possible an analysis of the legal basis for the roles of institutions is included in the following discussion.

Economic Instruments

Because the management of AnGR is a complex task, which involves a variety of stakeholders, implementation of legal measures may be difficult and costly. As noted above, it may be more cost-effective to use other mechanisms to achieve the desired objectives. Measures might include subsidies of various kinds – this of course is dependent on the economic means of the country and on compliance with international trade regulations. Measures to support the marketing of livestock products may be another means to foster and maintain AnGR diversity.

4.4 Country Reports analysis

In the following subchapters, legislative measures, institutional frameworks and other mechanisms for the management of AnGR at the country level are discussed.

Biodiversity-related legislation

Several countries report that they have legislation in place to implement the provisions of the CBD (see section E: 1). Some countries mention having instruments related to the conservation of biodiversity in general, without specifying whether AnGR is included. With respect to access issues, some countries report laws regulating access to genetic resources in general – examples include

Malawi[26], the Bolivarian Republic of Venezuela[27] and Colombia[28]. Others explicitly indicate that laws are in place to regulate access to AnGR. One example is India's Biodiversity Act (2002) which regulates access to plant and animal genetic resources by foreigners (Legal Questionnaire, 2003). CR Sri Lanka (2002) reports the preparation of a Biodiversity Act which covers access and benefit sharing for genetic resources including domestic animals.

Box 46
Malawi's Environmental Management Act

Articles 35 and 36 of the Environmental Management Act contain provisions on the conservation of biodiversity and on access to genetic resources. The Minister may assess and identify Malawi's biological resources before formulating and implementing policies and frameworks for their protection. The Act also contains suggested actions that the Minister may undertake for the conservation of biological resources. The Minister may also restrict access to Malawi's genetic resources, or impose fees or benefit sharing measures involving the owner of the technology and the government.

Source: Legal Questionnaire (2003)

Instruments related to supporting livestock production systems

This subchapter analyses legal instruments that create a facilitating environment for the management of AnGR. The link to AnGR is indirect – by sustaining specific production systems, these measures also sustain the associated AnGR. The Country Reports describe quite a diverse set of instruments of this type, varying according to the specificities of the production systems, and the objectives and challenges associated with the country in question.

Instruments related to agricultural development and land use

Included under this heading are instruments that aim to promote the development of rural areas and rural communities. These instruments may take the form of policy measures – see for example CR United Republic of Tanzania (2004) and CR Lesotho (2005); or be defined in legislative acts – such cases are reported from the Republic of Korea[29], Viet Nam[30] and Slovakia[31]. They may form part of a country's strategy for poverty reduction and food security (Box 49). Some explicitly regulate the development and modernization of agriculture (Honduras[32], Ecuador[33]), or the use of agricultural or arable land (Bosnia and Herzegovina[34], Georgia[35], Mexico[36]). Measures may also be put in place to address the problems of specific production systems. Mongolia for instance has created the legal basis for support of, and incentives for, grassland systems affected by severe weather conditions. Its National Program on Protecting Livestock from Natural Disaster, Dzud and Drought, approved under Resolution 144, of 2001 aims to strengthen damage relief systems – creating aid distribution networks, and enhancing the involvement of livestock keepers and administrative institutions (CR Mongolia, 2004).

Instruments related to pasture and rangeland management

In countries with large areas of rangeland and scarce water resources, a variety of measures are put in place to regulate access and management. These measures may fall under general legislation related to pastures and rangelands or be included in specific acts.

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[26] Environmental Management Act (Legal Questionnaire, 2003)
[27] Law of Seeds, Material for Animal Reproduction and Biological Inputs. Official Gazette of the Bolivarian Republic of Venezuela Number 37.552 of 18/10/2002 (CR Bolivarian Republic of Venezuela, 2003)
[28] Article 81 of the Political Constitution of Colombia, 1991 (CR Colombia, 2003)
[29] Rural Development Law and Rural Community General Law (CR Republic of Korea, 2004)
[30] Resolution No. 06 of Central Government (10/11/1998) (CR Viet Nam, 2003)
[31] Act No. 240 of 1998 (on Agriculture); Rural Development Plan of the SR 2004–2006 (E-mail Consultation Czech Republic, 2005)
[32] Decree No. 31/92 – Law for the Modernization and Development of the Sgricultural Sector (CR Honduras, undated)
[33] Law of Agricultural Development, Official Register No.55 of 30 April 1997 (Legal Questionnaire, 2003)
[34] Law on Arable Land, 1998 (CR Bosnia and Herzogovina, 2003)
[35] Agricultural Land Act (CR Georgia, 2004)
[36] Agricultural Law, 1992 (Legal Questionnaire, 2003)

Legislation in the area of general pasture and rangeland management is reported by countries including Kyrgyzstan[37] and Oman[38]. Measures may also be integrated into other legislation. CR Yemen (2003) reports that measures related to rangeland management are included under the country's environmental law, and Australia has a range of legal instruments at the Commonwealth and State Government levels that deal with biodiversity conservation and rangelands management. Other countries report having corresponding policies in place (examples include Uganda[39], Lesotho[40], Algeria[41] and Bhutan[42]), but the legal basis for these is not always clear.

The instruments may be directed specifically at the maintenance and/or improvement of pastures – examples include the laws reported by Uzbekistan[43], Pakistan[44], the Republic of Korea[45] and China[46]. Iraq's Government Law number 2, 1983 contains measures to improve natural pastures, to provide for rotational grazing, and to control toxic plants (CR Iraq, 2003). Turkey has integrated measures on pasture improvement in its leasing regulation (Box 47).

A number of countries indicate regulations relating to the prevention of pollution by manure run-off. Examples include the Republic of Korea's Sewage, Faeces and Urine, Waste and Water Treatment Law (CR Republic of Korea, 2004). The impact of laws regulating the run-off of manure is also mentioned in CR United States of America (2003) and CR United Kingdom (2002). CR Cook Islands (2003) indicates that the country's Environmental Law has had some effect on the size and distribution of livestock holdings, particularly pig farms. Similarly CR Kiribati (2003) mentions that under the Environmental Act of 1999, livestock development is a prescribed activity, and that new livestock farms require ministerial approval.

Norway promotes the organized use of pastures by grazing associations – the Decree Relative to Incentives for Organized Use of Pastures regulates the efficient use of pastures in outlying lands (FAOLEX). Incentives are provided for organized grazing under the control of registered grazing associations which meet set criteria (ibid.). Pakistan also has a substantial set of measures to regulate pasture use[47].

In extensive grassland systems, access to grazing land and water sources is crucial. This is especially true in the case of mobile pastoralism. Regulations covering the access of transhumant pastoralists to pastures are included in the pastoral codes and similar legislation, which exist in a number of African countries such as Benin[48], Botswana[49], Guinea[50], Mali[51] and Mauritania[52]. Guinea's Pastoral Code, for example, regulates pastoral land-use rights and provides for conflict resolution. It regulates the use of pastures, use of water resources, transhumance and protection of the environment (CR Guinea, 2003). Botswana's Tribal Land Act restricts the granting of land-use rights in land specified to be for grazing; grazing land may be set aside for commonage (FAOLEX). Access to pastures may also be important for sedentary livestock keeping communities. Laws relating to the allocation of pastures at the community level are found for instance in Turkey (Box 47) and Albania[53].

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[37] Law "on pastures" (CR Kyrgyzstan, 2003)
[38] Royal Decree No. 8 of 2003 issuing Law on Pasture and Animal Resources Management, 21 January 2003 (FAOLEX)
[39] Pasture and Rangelands Policy (CR Uganda, 2004)
[40] Livestock and Range Management Policy, 1994 (CR Lesotho, 2005)
[41] National Agricultural Development Plan (CR Algeria, 2003)
[42] National Pasture Policy (CR Bhutan, 2002)
[43] Law No 543-1 of 1997 on protection and usage of vegetation (FAOLEX)
[44] Punjab Frontier Grazing Regulation (E-mail Consultation Pakistan, 2005)
[45] Grassland Law (CR Republic of Korea, 2004)
[46] Grassland Law (CR China, 2003)
[47] Punjab Frontier Grazing Regulation, 1874; Grazing of Cattle in Protected Forests (Range Lands) Rules, 1978; By-laws for Regulating Grazing of Animals, 1981; Pasturage of Animal Rules, 1900 (Email Consultation Pakistan, 2005)
[48] Law No. 87of 21 September 1987 on the regulation of the animal guard, common grazing (la vaine pâture) and transhumance (Legal Questionnaire, 2003)
[49] Tribal Lands Act (FAOLEX)
[50] Pastoral Code (CR Guinea, 2003)
[51] Law No. 01-004 on the Pastoral Charter in the Republic of Mali (Legal Questionnaire, 2003)
[52] Law No. 44-2000 on the Pastoral Code in Mauritania (CR Mauritania, 2004)
[53] Instructions No. 1 of the General Directorate of Forests and Pastures on technical criteria for leases of pastures and meadows, 23 May 1996, implementing Law No. 7917 on protecting pastures and meadows, 13 April 1995 (FAOLEX)

Box 47
Turkey's Law on Pastures No. 4342 (1998)

This law sets out basic procedures and rules for the allocation of pastures to villages and municipalities. The Ministry of Agriculture and Rural Affairs is authorized to determine the boundaries of pastures, and their allocation to relevant entities. The finalized boundaries are recorded in corresponding title deeds. The allocation process is renewed every five years. Areas that can only be used after improvement measures can be leased to individuals and companies who undertake the improvement. Areas that are allocated under this law cannot be used for any other purposes unless written consent is obtained from the Ministry of Agriculture. This consent can only be given under specific conditions that are set out in the law. The law also has provisions to prevent overgrazing in these areas. A "Pasture Fund" will be established under the direct management of the Ministry of Agriculture for financing the activities set out in this law

Source: Legal Questionnaire (2003)

Several countries report laws regulating access to water. Examples include Chad's Order on Pastoral and Village Hydrology[54], and Mongolia's Resolution on the National Program on Protecting Livestock from Natural Disaster, Dzud and Drought (see above). Access to water may be included in other regulations, such as the above-mentioned pastoral codes. It is integrated, for example, under Australia's Land Protection Act[55].

Conservation of rural areas and organic/ecological agriculture

In industrialized countries, measures tend to be focused on conservation of the natural environment or maintaining rural areas rather than being aimed primarily at assuring food security. Such measures may indirectly foster the use of traditional, locally adapted breeds of livestock.

Box 48
Slovenia's Livestock Breeding Act (2002)

The principal objective of this act is to harmonize Slovenia's livestock breeding legislation with the "acquis communautaire" of the EU, and to adapt to the CAP. It also sets out principles in accordance with the goals of agricultural policy, and outlines the economic, spatial, ecological and social roles of animal husbandry and sustainable agricultural development. The more specific objectives of the act are:

- regulating the field of animal husbandry, with the aim of promoting stable production of quality food and ensuring food safety;
- conserving settlements in rural areas, and the cultivated landscape;
- utilizing natural resources for food production in such a way as to maintain the productive capacity and fertility of the land;
- managing the operation of recognized breeding organizations and the implementation of breeding programmes;
- providing a higher level of education in the field of animal husbandry;
- maintaining biodiversity in animal husbandry and protecting the environment; and
- providing a suitable income for those involved in agriculture.

Source: CR Slovenia (2003)

Legislation promoting the conservation of rural areas is particularly reported by European countries. Examples include Slovenia (Box 48) and Bosnia and Herzegovina[56]. Legal measures may be used to promote desirable changes in agriculture, and may support specific production methods such as ecological/organic farming. A number of European countries report such legislation. CR United States of America (2003) also mentions its National Organic Standards, and CR Brazil (2004) mentions programmes furthering organic meat production. In the case of organic production in particular, a clear legal framework is necessary to ensure consumer confidence (rules for production standards, labelling

[54] Ordinance No. 2/PR/MEHP/93, on the creation of the Office of Pastoral and Village Hydrology (CR Chad, 2003).
[55] Land Protection (Pest and Stock Route Management) Act 2002 – reprinted on 19 May 2005; Rural Lands Protection (General) Regulation, 2001 (FAOLEX)
[56] Law on Arable Land, 1998 (CR Bosnia and Herzogivina, 2003).

etc.). Industrialized countries may also have legislation supporting the maintenance of agricultural production in unfavoured areas. Examples include Switzerland's Agricultural Law (CR Switzerland, 2002). Slovenia's Livestock Breeding Act follows an integrated approach, outlining the economic, spatial, ecological and social roles of animal husbandry (Box 48).

Table 88
Instruments for sustaining livestock production systems

Types of instruments	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Agricultural development	[3]			3	2	2	
Pasture and rangeland management	3 [3]	3 [1]	3	4	5		1
Access to pastures and water	6		1	2	2		
Conservation of rural environments, ecological/ organic farming				10		1	1
Number of CRs	42	7	11	39	25	22	2

[n] = policies/strategies
Note that inclusion of instruments under two categories is possible

Some countries, particularly in Africa, mention that they have policies and strategies in place for agriculture, rangeland management or livestock production. However, from the information in the Country Reports it is difficult to know the legal basis of these measures – for example, whether they are based on a general legal frameworks relating to agriculture and land use, or on legislation relating to the competences and duties of a government agency. Similarly, it is often unclear whether they have to be approved by a legislative body. The example from Mozambique presented in Box 49 illustrates a strategy that is explicitly integrated in the context of the country's policies promoting poverty reduction and food security.

Box 49
Mozambique's Livestock Development Policy and Strategies

A new document on Livestock Development Policy and Strategies is presently submitted for approval. Its objectives are to contribute to poverty reduction and food security in rural areas, stimulating the role of livestock in families' socio-economic growth, and contributing to satisfying the needs of the national market. This policy has a lifespan of ten years.

Source: CR Mozambique (2004)

Institutions supporting livestock development

This subchapter discusses regulations related to institutions that have specific functions in AnGR management. Such institutions may be organized in a centralized or in a decentralized way. Several countries mention specialized central institutions involved in the management of livestock. Examples include Cape Verde's National Institute of Agriculture and Livestock[57].

The role of decentralized organizations such as cooperatives, community groups and farmers' associations varies from region to region. Organizations of this type are usually involved in a variety of activities related to AnGR management. Several African countries report legislation related to the recognition and functioning of rural cooperative groups at local level. CR Chad (2003), for example,

[57] Regulation No. 125/92 approving the constitution of the National Institute of Agriculture and Livestock, 1992 (FAOLEX)

mentions a decree[58] related to the recognition and functioning of rural groups, and an order[59] regulating the status of cooperative groups. Regulations affecting rural community organizations are reported in the Central African Republic,[60] and have also been put in place in Equatorial Guinea[61]. Botswana has instituted tribal Land Boards as corporate bodies – tilling rights and titles to land are vested in the Land Boards, which determine and grant customary forms of land tenure (FAOLEX).

Some countries in Latin America (e.g. Mexico[62]) and Europe (e.g. Poland[63] and Bosnia and Herzegovina[64]) report legislation regulating farmers' and breeders' organizations. These groups are conceived as professional associations, and represent the (economic) interests of the producers. Malaysia[65] and Pakistan[66] also report legislation on farmers' organizations and agricultural cooperative societies respectively.

Access to Credit

Access to credit provision tailored to the specific needs of livestock keepers is an important institutional requirement. This is a particular issue in countries with a poorly developed banking infrastructure. In some countries, especially in Africa, the state has taken initiatives in this field. Examples include the creation of the "Caisse de Développement de l'Elevage du Nord" in Cameroon[67]; the "Mutualité Agricole" in the Central African Republic[68], the projected law on an agricultural fund in the Congo[69]; Senegal's credit fund for crop and animal production[70], and Mozambique's Livestock Development Fund[71]. Another example of legislation in this field is Pakistan's "Cooperative Societies and Cooperative Banks (Repayments of Loans) Ordinance" of 1966 (E-mail Consultation Pakistan, 2005).

Instruments related to conservation

This subchapter covers legislative measures, policies and strategies for the conservation of AnGR (for definitions of the different types of conservation referred to in this subchapter, see Box 94 in Part 4 – Section F). A first step for the conservation of AnGR diversity is to identify and designate the breeds to be conserved. Conservation may have various motivations, including economic, sociocultural and scientific objectives. It may be aimed at conserving specific endangered breeds, or at maintaining AnGR diversity more generally.

Several examples of legislation relating to AnGR conservation are clearly culturally motivated. The Republic of Korea, for example, protects specific breeds as "national monuments" under the Cultural Properties Protection Law (CR Republic of Korea 2004). Some Canadian Provinces have designated "heritage breeds" or "heritage animals" in their legislation – the Canadienne cow, Canadien horse and Chantecler chicken in Quebec, and the Newfoundland Pony in Newfoundland and Labrador (CR Canada, 2003). In Peru, the Peruano de Paso horse, along with alpacas and llamas are regarded as national symbols (CR Peru, 2004), and legal measures have been put in place to protect them[72]. In the case of Japan, scientific value is also mentioned as a criterion – the Law for the Protection of Cultural

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[58] Decree No. 137 /P.R./MA/93 determining the modalities for the recognition and the functioning of rural groups and to allow women and men to be given responsibility in the development of the livestock sector
[59] Order No. 25/PR/92, regulating the status of cooperative groups and cooperatives
[60] Decree No. 61/215 of 30 September 1961 regulating agriculutral cooperatives and mutual plans in the Central African Republic (CR Central African Republic, 2003)
[61] Law of Cooperatives, Ministry of Labour, Malabo (Legal Questionnaire, 2003)
[62] Law of Agricultural Associations, 1932 and Law of Livestock Organizations, 1999 (Legal Questionnaire, 2003)
[63] Act on Social and Professional Agricultrual Organizations, 1982 (Legal Questionnaire, 2003)
[64] Law on Farmers's Associations (CR Bosnia and Herzogovina, 2003)
[65] Farmers' Organization Act, 1973 (CR Malaysia, 2003)
[66] Punjab Livestock Associations and Livestock Associations Unions (Registration and Control) Ordinance, 1979 (E-mail Consultation Pakistan, 2005)
[67] Decree No. 81/395 of 9 September 1981 modifiying and completing Decree No. 75/182 of 8 March 1976 (Legal Questionnaire, 2003)
[68] Decree No. 61.215 of 30 September 1961 (Legal Questionnaire, 2003)
[69] Projected law on the creation of the Agricultural Fund (Legal Questionnaire, 2003)
[70] Decree No. 99–733 (Legal Questionnaire, 2003)
[71] No legal basis indicated
[72] Decree No. 25.919 – declaring the De Paso horse as a native species of Peru, 1992

Properties (1950) designates autochthonous species, including livestock that have high scientific value, as "natural treasures" (CR Japan, 2003). In other cases, the motivation for legislative measures is more related to broader concerns about biodiversity (see for example Box 50 describing Slovenia's Regulation on Conservation of Farm Animal Genetic Resources of 2004).

In some cases, strategies may be directed at the conservation of particular species, – for example Peru's *in situ* and *ex situ* measures to conserve alpacas and vicuñas (CR Peru, 2004). In other cases, conservation measures are integrated within broad programmes for the management of AnGR such as Mongolia's programme on "Improving Livestock Quality and Breeding Services"[73]. Programmes may be supported by additional measures such as promoting scientific research (CR Kazakhstan 2003; E-mail Consultation the Netherlands, 2005; CR Ukraine 2004), or awareness building among farmers (CR India, 2004). If programmes are to be properly targeted, measures for the characterization and inventory of AnGR are required, along with the establishment of procedures for the identification and registration of the breeds and animals to be covered by the programmes (Box 50).

Box 50
Slovenia's regulation on Conservation of Farm Animal Genetic Resources

This regulation establishes systematic procedures for monitoring and analysing the state of AnGR diversity, and defines means and instruments for *in situ* and *ex situ* conservation. It establishes a register which includes a zootechnical assessment of breeds and species. It also provides definitions of degrees of breed endangerment and criteria for the estimation of genetic variability within breeds.

Source: E-mail Consultation Slovenia (2005)

In situ in vivo conservation

In contrast to the above-mentioned measures providing general support to livestock production systems, the measures analysed in this section relate directly to the conservation of AnGR. Only a small minority of countries (mostly from the Europe and the Caucasus region) report legislation covering *in situ* conservation of AnGR (Table 89). Various strategies and mechanisms to support this type of conservation can be implemented. Some countries grant financial support to breeders, breeders' organizations, or other institutions that maintain traditional breeds (e.g. Japan[74] and Greece[75]); or to NGOs that promote and manage *in situ* conservation (e.g. Switzerland[76]).

Few such measures are reported from developing countries. CR Ghana (2003) mentions efforts by the Animal Research Institute to support five communities in the Northern Region keeping Ghana Shorthorn cattle. However, the exact mechanisms involved are unclear. In India, conservation programmes under the National Bureau of Animal Genetic Resources include the establishment of *in situ* conservation units in the native tract of the breed, performance recording, selection and registration of genetically superior animals, and the provision of incentives to the owners of the animals to retain them for breeding. These measures are combined with *ex situ in vivo* and *in vitro* conservation for specific breeds (CR India, 2004). However the Country Report does not provide information on the legal framework for these measures. Another type of programme is reported in CR Peru (2004) – involving the designation of specific zones for the rearing of vicuñas in semi-liberty to reclaim their wool.

Ex situ in vivo conservation

Again, only a limited number of countries indicate that they have instruments in place related to *ex situ in vivo* conservation (Table 89). Examples include Slovenia and Ukraine (Boxes 50 and 52). In Indonesia, the Law on Animal Husbandry and Health[77] requires that conservation programmes are conducted in well-managed areas such as on smaller islands, and or in certain Village Breeding

[73] Based on the Law on Livestock Gene-pool Protection and Health (CR Mongolia, 2004)
[74] Law for the Protection of Cultural Properties – grants provided to municipalities affected by measures (CR Japan, 2003)
[75] Presidential Decree No. 434/95; Decision 280/343571/4969/8.9.97 of the Ministers of Agriculture and Economy; 167/08.03.95 Decision of the Minister of Agriculture (CR Greece, 2004)
[76] Subsidy based on the Law of Agriculture (CR Switzerland, 2002)
[77] No. 6 of 1967, Article 13 (CR Indonesia, 2003)

Centres, or on private and government farms (CR Indonesia, 2003). Malaysia,[78] and India (CR India, 2004) have networks of conservation farms, and Sri Lanka's Zoological Garden Act covers zoo farms (E-mail Consultation Sri Lanka, 2005).

In vitro conservation (cryoconservation)

Several countries report legislation relating to conservation in *in vitro* facilities. One example is Uganda, which has comprehensive legislation in the field AnGR management (Box 59). In the United States of America, the Food Agriculture, Conservation and Trade Act (1990) established the conservation of AnGR as a national priority (CR United States of America, 2003). As a result, the National Animal Germplasm Program was initiated in 1999, and is developing a comprehensive management strategy for AnGR, including the establishment of cryoconservation measures. Measures regulating procedures for access to gene-banks and transfer of genetic material are reported only by the Czech Republic. Its Breeding Act Amendment[79] and the associated implementing regulation and programme also include a model "genetic material provision and transfer agreement".

Table 89
Instruments in the field of conservation

Type of Conservation	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
In situ				8	3	1	1
Ex situ in vivo				2	4		
Ex situ in vitro	1			6	3	2	1
Number of CRs	42	7	11	39	25	22	2

Note that a measure may be included under more than one category. Details of conservation programmes are reported in Section C.

Institutions involved in the conservation of AnGR

A number of countries report measures to establish institutions responsible for conservation. For example, Uganda's Animal Breeding Act (2001) established the National Animal Genetic Resources Center and Databank, which is responsible for overseeing conservation measures (Box 51).

Box 51
Uganda's National Animal Genetic Resources Programme

The main objectives of the National Animal Genetic Resources Programme are to ensure the conservation and sustainable full use of AnGR diversity. The programme is charged with developing a national AnGR conservation policy including *in situ* and *ex situ* measures; establishing an appropriate institutional framework for coordinating, regulating and monitoring conservation activities; creating awareness among the population of current initiatives related to AnGR management; characterizing and documenting the country's livestock breeds; and promoting research.

Source: CR Uganda (2004)

Other examples include Ukraine (Box 52), Kazakhstan[80] and the above-mentioned National Animal Germplasm Program in the United States of America.

[78] Based on Animals Ordinance of 1953 and the National Policy on Biological Diversity, launched by the Ministry of Science, Technology and Environment (CR Malaysia, 2003; Legal Questionnaire, 2003)
[79] Breeding Act Amendment 154/2000 (E-mail Consultation Czech Republic, 2005)
[80] Law of Pedigree Animal Breeding, and respective sublegislative acts (CR Kazakhstan, 2003)

Box 52
Ukraine's Law on Animal Breeding

In Ukraine, the conservation of threatened breeds of all species is an integral part of the Law on Animal Breeding. Conservation work is implemented by a specially created centralized body with executive authority financed from the state budget. The programme involves a range of activities, including preserving frozen semen from high-output breeds, strains and breeding groups that are at risk of extinction; the use of reproductive biotechnologies in breeding and selection work; and the organization of exhibitions and auctions of breeding animals.

Source: CR Ukraine (2004).

CR Bolivarian Republic of Venezuela (2003) reports a National Centre for the Conservation of Genetic Resources (animal and plant species) under the Ministry of Environment, created by the Law on Biological Diversity. Turkey has established an interministerial and multistakeholder committee for AnGR (Box 53).

Box 53
Turkey's Regulation on Protection of Animal Genetic Resources (2002)

This regulation, based on the Livestock Improvement Act No. 4631, sets forth procedures and principles regarding all activities related to the protection and registration of AnGR in Turkey. A National Committee on Protection of AnGR is established, composed of representatives of: (a) the General Directorate of Agricultural Research; (b) the General Directorate of Agricultural Enterprises; (c) the Faculty of Veterinary Sciences; (d) the Faculty of Agriculture; (e) the Ministry of Environment; (f) the Ministry of Forestry; (g) the Central Council of the Union of Turkish Veterinarians; (h) the Society for Protecting Wildlife; (i) the Society for Protecting Turkish Habitat; and (j) the Anatolian Horse Breed Development Society. The functions of this Committee include: determining activities regarding the protection of AnGR; reviewing past activities and planning future actions; specifying breeds under threat of extinction; formulating policies for the protection of AnGR; and taking decisions regarding the import and export of AnGR.

Source: Legal Questionnaire (2003)

Instruments related to genetic improvement

Genetic improvement encompasses a broad range of activities related to the breeding process, including animal identification and herd book keeping, performance recording, genetic evaluation, and the dissemination of improved genetic material. Many countries have legal measures in place to regulate some or all of these activities. Legislation may also cover the exchange of breeding stock, both within and between countries. The following aspects of legal frameworks are discussed in this subchapter:

- the definition of breeding strategies and programmes;
- animal identification and registration systems;
- infrastructure and institutional issues related to AI and natural service – including sanitary control measures.

Table 90
Instruments in the field of genetic improvement

Type of measure	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Definition of breeding strategies, genetic improvement and selection	6	0	2	17	11	4	0
Registration, Branding	5	1	1	21	5	10	0
Laws for reproductive biotechnology	2		1	18	5	5	1
Number of CRs	42	7	11	39	25	22	2

Details of genetic improvement programmes are reported in Section B.

Table 90 shows that Europe and Asia have the greatest density of legal regulations in the field of genetic improvement. Conversely, in African countries, policies are less likely to be backed up by legal frameworks. In some countries, legislation is currently being developed and has not yet been implemented. A number of developing countries report difficulties in implementing their policies and programmes in this field.

The definition of breeding strategies

The goals of the breeding strategies differ from country to country. Several countries mention breeding policies directed at optimizing the utilization of indigenous breeds, either by straight-breeding or focused cross-breeding. In Nigeria, for example, breeding and selection of indigenous breeds the ecological zones to which they are adapted is encouraged; but there is also promotion of controlled cross-breeding of indigenous dairy cattle to a level not exceeding 50 percent exotic blood (E-mail Consultation Nigeria, 2005). Other examples include India, which has a strategy promoting genetic improvement in indigenous cattle and buffalo breeds, but also promotes the cross-breeding of local animals with Jerseys or Holstein-Friesian (CR India, 2004), and Trinidad and Tobago which promotes genetic improvement of the local Criollo goat breed (CR Trinidad and Tobago, 2005). Serbia and Montenegro[81] and China[82] have measures in place promoting the use of both, indigenous and exotic cattle breeds. Some countries have laws relating to specific species or breeds. Examples include Argentina's recovery programme for sheep[83]. Lesotho has legislation limiting the import of livestock to those meeting the requirements of the national breeding objectives (Box 54).

[81] The law on Measures for Livestock Improvement regulates the sustainable management of both locally adapted breeds and imported foreign breeds (FAO, 2005)
[82] CR China (2003); Legal Questionnaire (2003)
[83] Law for the Revival of Sheep Keeping N 25422, 27 April 2002 (Legal Questionnaire, 2003)

Box 54
Lesotho's Importation and Exportation of Livestock and Livestock Products Proclamation

The Importation and Exportation of Livestock and Livestock Products Proclamation 57 of 1952 amended in 1953, 1954, 1965 and 1984 dictates: (a) that livestock should not be imported or exported without permit; (b) that no permit shall be granted for importation of "undesirable livestock", including but not limited to bastard sheep and goats; (c) that conditions for importation should include desirability of the animals including their ability to improve the standard of livestock in the country.

These legal instruments influence breed utilization. Merino sheep and Angora goats are being reared in larger numbers than any other breeds. The laws also encourage use of Merino sheep in mountain zones, and higher concentrations of the breeds are, therefore, found in these areas. The import controls have allowed improvement of the country's livestock, as imports are restricted to superior Merino rams, Angora bucks, and beef and dairy bulls.

Source: CR Lesotho (2005)

Another example of laws regulating the use of animals for breeding is Malaysia's Animals Ordinance (Box 55).

Box 55
Malaysia's Animals Ordinance

This ordinance prohibits the possession of a bull, older than 15 months, that is not sterilized. Exceptions can be granted for bulls suitable for reproduction. These bulls are tested (health and breeding criteria) and registered by an official agency. Breeding is only allowed utilizing registered stud bulls.

Source: CR Malaysia (2003)

Animal registration and identification

Various aspects of AnGR management require systems for animal identification and registration if they are to be effective. Examples include the implementation of veterinary control measures or traceability rules related to food safety, the prevention of theft, monitoring the status of breed populations, and the implementation of breeding and conservation programmes. A clear and enforceable legal basis for registration and identification is likely to be particularly necessary where public goods such as food safety or the prevention of epidemic livestock diseases are the main objectives. For targeted breeding, more elaborate recording methods (e.g. herd books) are required and normally encompass the documentation of the genealogy of pedigree animals and the performance of the offspring. Systems of this type necessitate regulation to ensure uniform standards.

Identification and registration may be organized in different ways depending on the objectives and the availability of resources. Tasks may be implemented by a central state agency, or be delegated to decentralized institutions, such as breeders' organizations or state breeding farms. Elaborate registration systems require a high degree of organization and cooperation. In some countries registration is, therefore, limited to specialized breeding herds or breeding farms (E-mail Consultation Nepal, 2005), to species of particular importance, or to commercially oriented farms and enterprises.

Europe, with its highly organized breeding systems (breeders' organizations in western Europe and state agencies in eastern Europe), has the highest density of measures related to animal registration (Table 90). Elsewhere in the world, some countries mention animal identification and registration as a "big goal" or "urgent need", that they would like to review or improve their current practices, or that they are at present developing a policy. Some also indicate that at present they are unable to monitor the population status of their breeds, and that a lack of registration measures for pure-bred traditional breeds hinders their further development.

Reproductive biotechnology

In this subchapter, an overview of regulations and policies related to the utilization of biotechnology (principally AI and ET) for genetic improvement is presented. Table 90 gives a regional breakdown of the instruments in place. In parallel with the greater use of reproductive biotechnologies in developing countries, Europe and the Caucasus has the highest density of legislation in this field. Many

developing countries regard the use of reproductive biotechnologies as an important means of improving productivity, particularly in dairy production. Examples include the AI programme in Sri Lanka, which aims to upgrade cattle, buffalo, goat and pigs in order to promote commercial production systems; cattle semen used in the country is mostly of the *Bos taurus* type imported from the EU, North America or Australia (E-mail Consultation Sri Lanka, 2005). Legislation related to technical requirements such as the production and transportation of semen, health controls, and the organization of AI centres and semen banks, is reported by a number of countries. Hungary's Decree No 39 of 1994 serves as an example of such legislation (Box 56).

Box 56
Hungary's Decree No 39

Decree 39 of 1994 of the Ministry of Agriculture regarding artificial insemination (AI), embryo transfer (ET) and the production, supply, marketing and utilization of breeding materials, applies to cattle, sheep, goats, horses, pigs and red deer. Articles 2 to 6 deal with AI centres. Such centres require authorization for their operation, issued by the National Agricultural Classification Institute (NACI). Authorization depends on certain conditions specified in Article 2. Centres shall contract with interested breeding organizations, to perform the duties listed in Article 5. Semen may be collected only from animals authorized for AI. Provisions regarding authorization for AI are laid down in Articles 7 and 8. Article 9 deals with the supply of semen, which may be produced only by AI centres. The marketing of semen is regulated by Article 10. Special regulations regarding the marketing of imported semen are set out in Article 11. Inspection of AI centres is performed annually by the NACI, which may prolong authorization, specify conditions, or withdraw authorization if standards are not met (Article 14). ET is regulated in Articles 15 to 24, and centres again require authorization to operate. Standards related to all these activities are controlled by the NACI. A list of authorized centres, prohibited reproductive material in the case of cattle, and the list of male animals authorized for AI are published in the official gazette of the Ministry.

Source: Legal Questionnaire (2003)

Control of the health of breeding stock and of genetic material

Several countries, particularly in Europe, indicate that they have regulations related to the health of breeding animals (either in the context of the production of semen for AI or covering animals used for natural service).

Box 57
Botswana's Stock Diseases (Semen) Regulations

According to these regulations, a permit is required for introducing semen into the country (to prevent the introduction and spread of disease); for disposing of semen (sale, gift, exchange, or in any other manner); and for using any such semen for artificial insemination of any stock that are not the property of the owner of the semen.

Source: Legal Questionnaire (2003)

Other examples include Malaysia's Animals Ordinance (Box 55), and Japan's requirement for all breeding animals (cattle, horses and pigs) to have a breeding stock certificate[84]. The certificate is issued after annual inspection, which includes inspection for infectious diseases and genetic disorders. Some countries have rules in place related to the prevention of specific livestock diseases. For example, Norway's BSE-related restrictions on imports of cattle and beef from the United Kingdom include restrictions on the import of embryos.[85]

Incentives for genetic improvement

Many countries report incentives that in one way or another influence breeders' activities and may indirectly promote genetic improvement – examples include subsidies for capital investments or subsidized provision of inputs of various kinds. In this subchapter, only subsidies directly connected with livestock breeding are discussed.

[84] Law for Improvement and Increased Production of Livestock (E-mail Consultation Japan, 2005)
[85] Decree No. 548 of 2000 relative to protection measures against BSE in relation with importation from the United Kingdom (FAOLEX)

There are various types of subsidies which may be granted. Viet Nam[86], for example, reports a subsidy fund for maintaining and improving livestock and poultry breeding herds/flocks. Kazakhstan subsidizes measures that enhance availability of pedigree breeding materials to farmers (CR Kazakhstan, 2003). Several countries report subsidies supporting breeding infrastructure and technology. In many countries, the public sector is involved in the provision of services such as AI at subsidized rates, or may subsidize private sector providers (see Section D).

Box 58
Barbados's incentive programme

Because of high prices for fresh pork offered by supermarkets and other wholesale buyers, many producers have been selling underweight animals, including gilts, for slaughter. This could undermine the genetic base of the national pig herd. In response, the government has proposed offering producers an incentive of BDS$500 (approximately US$250) not to slaughter, or sell for slaughter, any gilt deemed by the Ministry of Agriculture and Rural Development to be suitable for breeding. The programme is to be carried out in collaboration with the Barbados Agricultural Society and the Barbados Pig Farmers' Cooperative Society Limited.

Source: CR Barbados (2005)

Other measures may include enhancing access to credit, granting tax advantages, providing loans at preferential terms, or providing emergency funding for breeding activities. Examples include measures put in place in Mexico, which allow a tax break for those involved in raising cattle[87] and Argentina, which has created a sheep bank and emergency fund[88].

Institutions dedicated to genetic improvement

This subchapter discusses the various institutions described in the Country Reports that facilitate planned and structured genetic improvement programmes.

A number of countries report specialized institutions dedicated to AnGR development. Such institutions may be mandated to perform activities in various areas of AnGR management, including: the elaboration of programmes and strategies (e.g. Uganda[89]); management of a specific branch of AnGR development and production (e.g. AVICOLA in Mozambique[90] and Moldova's institutions for pigs and poultry production – see below); research and extension (e.g. Costa Rica[91] and Mauritius[92]); and research on breed improvement (e.g. Bolivia[93] and Canada[94]). The institutions may be specialized governmental agencies, possibly combining experts from different departments (CR Costa Rica, 2004), or consultative groups of experts such as the Commission on Biotechnology in the Netherlands (E-mail Consultation the Netherlands, 2005). Tasks may be delegated to private or public–private bodies.

Specialized governmental institutions for research, extension and the elaboration of development programmes have been created in Uganda – National Animal Genetic Resources Steering Committee under the Ministry of Agriculture[95], Costa Rica – the National Institute for Agricultural Innovation and Technology Transfer (INTA)[96], Chile – the National Commission for the Development of Technology,[97] and Bolivia – National Centre for the Genetic Improvement of Bovine Cattle[98].

[86] Decision 125/CT dated 18/4/1991 (CR Viet Nam, 2003)
[87] Decree (tax benefits) n 6/2/94, 02 June 1994 (Legal Questionnaire, 2003)
[88] Resolution (Sheep Bank for Agriculture and Livestock Emergency) N. 143, 25 July 2002 (Legal Questionnaire, 2003)
[89] The National Animal Genetic Resources Databank, under the Animal Breeding Act (CR Uganda, 2004)
[90] Decree No. 5/78 creating the National Institution of Poultry Breeding (AVICOLA) under the Ministry of Agriculture. Its range of action covers all types of poultry production (industrial or traditional) (Legal Questionnaire, 2003)
[91] INTA (National Institute for Agricultural Innovation and Technology Transfer), (Law No 8149, 5 November 2001) (CR Costa Rica, 2004)
[92] AREU (Agricultural Research and Extension Unit) (CR Mauritius, 2004)
[93] National Center for the Genetic Improvement of Bovine Cattle. Ministerial Resolution 080/01 of MAGDER (Ministerio de Agricultura Ganadaria y Desarrollo Rural) (CR Bolivia, 2004)
[94] Experimental Farm Stations Act (CR Canada, 2004)
[95] Animal Breeding Act, 2001 (CR Uganda, 2003)
[96] Organic Law of the Minsitry of Livestock Law No. 8149, of 5 November 2001 (CR Costa Rica, 2004)
[97] Decree (National Commission for the Development of Biotechnology) n.164, 21 June 2002 (Legal Questionnaire, 2003)
[98] Ministerial Resolution 080/01 (CR Bolivia, 2004)

Private organizations and mixed public–private institutions may also be involved in the management of AnGR. Such organizations are reported from Cameroon – Société de Développement et d'Exploitation des Productions Animales (SODEPA)[99]; and Moldova – scientific production institutions for pigs and for poultry ("Progress" and "Moldptitseprom") (CR Moldova, 2004). Another example is the United Kingdom's Milk Council[100].

As mentioned above, registration of breeding livestock or breeds can either be organized by central or decentralized governmental agencies, or be delegated to private stakeholder groups, frequently to recognized breeders' organizations.

Legislation on centralized breeding registers is reported by Uganda (combined with the National Genetic Resources Databank), Cuba[101], the Russian Federation[102], Ukraine[103] and Estonia[104]. Decentralized institutions are reported by Jamaica[105], Guatemala[106], and Canada[107]. Nepal has registration schemes for organized farms and governmental farms (E-mail Consultation Nepal, 2005). The EU has a body of legislation regulating pedigree certificates, the keeping of herd books, genetic evaluation and performance testing (see Section E: 3.2). Examples of measures for the registration of specific breeds include Slovenia's Law on Conservation of Farm Animal Genetic Resources, which establishes a register of breeds including a zootechnical estimation (see above) and the provisions for breed registration mentioned in CR Russian Federation (2003). In China, the Stockbreeding Law of 2005 provides for the establishment of a national protection list of livestock and poultry genetic resources (FAOLEX).

In some countries, in particular where there is a lack of strong, decentralized breeding organizations, specific institutions, such as governmental farms and controlled nucleus herds play the dominant role in developing and producing breeding material. These institutions may also be involved in conservation programmes. Examples include Indonesia's policy for conservation and utilization of AnGR[108]. Mongolia has a programme on "improving livestock quality and breeding services[109]." Its major objective is to improve yield and product quality by creating nucleus herds and corresponding livestock breeding services (CR Mongolia, 2004).

Box 59
Uganda's Animal Breeding Act (2001)

The government has taken steps to support the breeding structure by identifying National Animal Genetic Resources Centre farms and ranches where specific breeding activities can be undertaken. However, securing sufficient funding for operationalizing the infrastructure remains a problem.

Source: CR Uganda (2004)

Breeders' associations and, in some cases, private companies may be delegated various functions in the process of genetic improvement. Breeders' associations often take responsibility for herd book keeping. Their duties and competences are usually defined in livestock breeding acts. The role of breeders' associations is particularly prominent in Europe. The EU has a body of legislation in place covering the recognition of breeders' organizations and regulating their activities (see Section E: 3.2). Few African countries report the existence of breeders' associations. The fostering of such societies is, however, one of the objectives of Uganda's National Animal Genetic Resources Centre and Databank established under the Animal Breeding Act of 2001 (CR Uganda, 2004).

[99] Decree No. 81/395 of 9 September 1981 modifiying and completing Decree No. 75/182 of 8 March 1975 on the creation of SODEPA (Société de Développement et d'Exploitation des Productions Animales) (Legal Questionnaire, 2003)
[100] Milk Development Council (Amendment) Order 2004 (FAOLEX)
[101] Law No. 1.279 – Law of Livestock Registration, 1974 (Legal Questionnaire, 2003)
[102] CR Russian Federation (2003)
[103] Law "About Animal Breeding" (CR Ukraine, 2004)
[104] Animal Breeding Act (CR Estonia, 2004)
[105] Recording by breed societies (CR Jamaica, undated)
[106] Governmental Accord 843-92 (CR Guatemala, 2004)
[107] Animal Pedigree Act, 1985 (CR Canada, 2004)
[108] Law on Animal Husbandry and Veterinary Act No. 6/1967, Article 13 (CR Indonesia, 2003)
[109] Based on the Act on Livestock Gene-Pool and Health Protection 1993; amended 2001 and approved by Resolution 105, 1997

Box 60
Guatemala – decentralization of the registration of pure-bred animals

Guatemala initially established a centralized register in 1915. A regulation in this field was introduced in 1933. It defined the criteria for inclusion in the register of pure-bred animals. Its goal was to resolve the problem of registering the many pure-bred animals that at the time did not have pedigree documentation. This situation prevented an "open-book" strategy at this time. In 1965, the regulation was adopted by all Central American countries as a basis for registration procedures. In 1992, a law for the decentralization of registration was adopted, and in the following years, the herd books of breeders' associations were officially recognized in several livestock species.

Source: CR Guatemala (2004)

Table 91
Instruments related to institutions active in genetic improvement

Institutions	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Institutions R+D							
incl. scientific councils:							
Government	5			3 (+1 mixed)		3	2
Stakeholder				4			
Breeding infrastructure	2			1	2 [2]*	1	1
Registration by government	2			4	3	1	1
Stakeholder associations							
Registration				6?	4	2	1
Improvement				2			
Number of CRs	42	7	11	39	25	22	2

[n] = created by policies

Instruments related to marketing and trade

This subchapter discusses instruments put in place to promote and regulate the marketing and trade of livestock and livestock products. Such measures include those related to the setting of standards for marketed products, those that promote trade or establish institutions in this field, and those that regulate the movement and exchange of animals both internationally and within countries.

Standard setting

There are two main objectives of legislation related to standard setting: 1) to ensure food safety and to address food-related aspects of human health through setting minimum quality standards; and 2) to provide for the identification of quality products by the consumer in the marketplace.

Various types of instruments related to ensuring food safety are reported. Examples include the Comoros's Decree No 87-019/PR, which relates to the production, storage, distribution and inspection of food products (CR Comoros, 2005). Other countries report regulations on grading of various animal products. Pakistan, for example, has rules related to the grading of agricultural products in general, and specific rules for milk, animal hair, eggs, ghee and creamy butter (E-mail Consultation Pakistan, 2005). Other regulations cover the production of specific food products, such as meat (including measures related to slaughtering), eggs and milk products (including the sale of raw milk). These various types of measure may be integrated into a general regulatory framework – as is the case in Pakistan (ibid.).

Instruments aimed at providing information for the consumer may have various goals: the assurance of quality standards; identification of geographical provenance or a specific production method (e.g. organic); or to indicate the source of the raw materials to provide reassurance regarding food safety. The most frequently mentioned instruments are those related to organic production. The EU has a body of legislation in this field, covering the production, labelling and inspection of organic products, and establishing rules for the use of geographical indications and similar designations (see Section E: 3.2).

Table 92
Instruments in the field of standard setting

Instruments in place for Standard Setting	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Food Safety	4 [1]	0	1	3 [1]	4	3	0
Consumer Information	0	0	0	6	0	1	1
Number of CRs	42	7	11	39	25	22	2

[n] = policies or legal basis unclear

Instruments to foster trade in livestock products

Marketing measures can be used for a variety of purposes. The objective may be to support the incomes of livestock keepers or to promote exports. Measures of this kind may also serve to foster AnGR diversity by helping to make production from a broader range of breeds economically viable. Various instruments can be used to promote trade and marketing, including:

- the establishment of governmental institutions to further marketing in general, such as Malaysia's Federal Marketing Authority[110] or the establishment of the Animal, Animal Products and By-products Marketing Development Authority in Ethiopia[111];
- the creation of governmental institutions to foster specific products – such as Nicaragua's National Dairy Products Company[112] and Sri Lanka's National Livestock Development Board[113];
- the creation of public–private partnerships – this occurs mainly in the dairy sector;
- the implementation of policies, strategies and programmes, either to support animal product marketing in general or the marketing of specific products – such as Mongolia's programmes for milk and wool products (Box 61) and the Philippines' "White Revolution" programme (Box 62);
- development of niche markets – reported examples include efforts in Botswana to promote exports of donkey meat, and ostrich meat and skin, and in Eritrea to market products from rare breeds (CR Botswana, 2003; CR Eritrea, 2003);
- supporting and regulating specific production methods (e.g. by legislation on organic agriculture or labelling);
- the implementation of measures to protect local producers from competition by imports (importation quota, taxes) – examples mentioned in the Country Reports include the Dominican Republic's Tariff Protection for Chicken Meat[114], and several regulations by which Egypt banned the importation of fertilized eggs and chicken meat in order to foster the development of its poultry industry (CR Dominican Republic, 2004; CR Egypt, 2003) (measures of this type have in recent years tended to be replaced by other means of supporting local farmers);
- the regulation of specific marketing methods (such as the regulation of public auctions of alpacas and llamas in Peru[115]): and

[110] Federal Agricultural Marketing Authority Act, 1965 – revised 1974 (CR Malaysia, 2003)
[111] Animal, Animal Products and By-products Marketing Development Authority Establishment Proclamation (No. 117/1998 (FAOLEX)
[112] Decree 364. Law of the Nicaraguan Dairy Agroindustry Corporation 31/05/88 (CR Nicaragua, 2004)
[113] State Agriculture Cooperation Act. No. 11 of 1972 by a gazette order dated 4th May 1972 (CR Nicaragua, 2004)
[114] Decree Number 505-99, November 1999
[115] RM Number 0424-AG (regulation of public auction of alpacas and llamas) (CR Peru, 2004)

- the establishment of networking opportunities for stakeholders in the food-processing and marketing sectors such as Mongolia's Wholesale Network Programme (CR Mongolia, 2004).

Box 61
Mongolia's White Revolution Programme

The "White Revolution" Programme, which has been in place since the adoption of Government Resolution 105 of 1999, aims to mobilize local resources in the livestock sector; improve the supply of dairy products, and increase the incomes of herders and rural people by reviving traditional processing of dairy products, developing small and medium-scale enterprises, and creating favourable conditions for marketing.

The Cashmere Programme was adopted by Government Resolution 114 of 2000 with the objectives of improving the competitiveness of cashmere products through improving the processing facilities. The Wool Sub-Programme was approved by Government Resolution 26 of 2001. Its objective is to enhance the capacity of factories involved in wool, skin and hide processing.

Source: CR Mongolia (2004)

Box 62
The Philippine's White Revolution

The approach to dairy development has involved both smallholders and commercial producers. The Philippine Dairy Corporation was created in 1979 to spearhead the development of the dairy industry based on small-scale production to increase rural income. Import of 2 400 head of Holstein-Friesian-Sahiwal cattle started in 1984 under an ADB–IFAD project. These animals were dispersed to various farmers' cooperatives. The National Dairy Authority (NDA) was created under the National Dairy Development Act RA 7884 to accelerate the development of the country's dairy industry.

The "White Revolution" was launched in 1999 under the leadership of the NDA and the Philippine Carabao Center. It aimed to drum up support from all sectors of society – farmers and rural families, the government extension and financing organizations, legislators, private investors, consumers, children and commercial processors.

Source: CR Philippines (2003)

Institutional Aspects of Marketing

Institutions for the marketing of AnGR products, sometimes as public–private partnerships, exist in a number of countries. These measures can either be focused on livestock products in general, as in case of the Livestock Development Council in the Philippines, which has the task of increasing the supply of livestock and livestock products to attain self-sufficiency (CR Philippines, 2004). Alternatively, they target specific markets such as dairy products[116], meat[117] or poultry[118]. Several examples of this second type of institution are reported. For instance, Mozambique has established "Avicola", the National Institution for Poultry Breeding, under the Ministry of Agriculture[119]. Egypt has a General Union of Poultry Producers.[120] Cameroon mentions its Société du Développement et de l'Exploitation des Productions Animales[121]. Nicaragua reports associations in various production areas – the dairy agro-industry[122], bird raising[123], and meat[124].

[116] Jamaica's Dairy Board; Nepal's National Dairy Development Board Act, the Milk Development Council in the United Kingdom; and Nicaragua's of the DairyAgroindustry Corporation (CR Jamaica, 2002; CR Nepal, 2004; CR Nicaragua, 2004; FAOLEX)
[117] Sri Lanka's National Livestock Development Board (CR Sri Lanka, 2002)
[118] Punjab Livestock, Dairy and Poultry Development Board (CR Pakistan, 2003)
[119] Decree No. 5/78 creating the National Institution of Poultry Breeding (AVICOLA), 1978 (Legal Questionnaire, 2003)
[120] Ministerial Resolution No. 97 implementing Law No. 96 of 1998 regarding the creation of the General Union of Poultry Producers (FAOLEX)
[121] Decree No. 81/395 of 9 September 1981, modifying and completing Decree No. 75 of 8 March 1976 (CR Cameroon, 2003)
[122] Decree 364, Law of the Nicaraguan Dairy Agroindustry Corporation, 31/05/88; Decree No. 82. Creating a Development Fund for the Dairy Industry, 23/07/66 (CR Nicaragua, 2004)
[123] Decree 357, Law creating the Nicaraguan Poultry Corporation, 31/05/88 (CR Nicaragua, 2004)
[124] Decree 360, Law creating the Nicaraguan Meat Corporation, 31/05/88(CR Nicaragua, 2004)

Table 93
Instruments for promoting trade in livestock products

Instruments	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Legislation to foster trade in AnGR products							
Marketing in general	2 [1]			2 [1]	[2]	1	
Specific Products	1 [1]				3 [1]	1	
Organic/ Niche	[2]			3 [3]		1	1
Institutions	3 [1]	1			3	3	
Protective measures, and subsidies	2		1	2	1		
Number of CRs	42	7	11	39	25	22	2

[n] = policies or legal basis unclear
Note that institutions may promote specific products or marketing of products in general. These cases are indicated under both, "institutions" and "laws to foster trade".

Import and export of genetic material

Under this heading, legislation on the import and export of genetic material in the narrow sense (semen and embryos) is presented. Import and export of live animals is discussed below under livestock movement and trade. In several cases it is not clear from the information available whether import/export of semen and embryos is included under regulations covering livestock trade, or on the import/export of livestock products. Regulations on import and export of genetic material are motivated by a variety of objectives, which vary from country to country. Preventing the introduction of livestock disease is an important motivation. Other objectives may include ensuring that the imported genetic material is adapted to local ecosystems, or increasing the output of national livestock production. There may also be legislation in place implementing the provisions of the CBD related to the need to obtain governments' prior informed consent for the export of genetic resources.

Table 94
Instruments regulating import and export of genetic material

Regulations relating to	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Import	7	3	3	26	6	5	
Export	4	2	0	23	1	0	
CBD implementation	1				1	1	
Number of CRs	42	7	11	39	25	22	2

In Europe in particular, there is a high density of regulation related to the import and export of genetic material. Box 63, which describes regulations controlling semen imports to the Russian Federation, provides an illustrative example.

Box 63
Russian Federation – Veterinary and Sanitary Requirements No. 13-8-01/1-8 (1999)

For boar semen to be admitted to the territory of the Russian Federation, it must have been collected at AI centres that are kept under permanent supervision by the state veterinary service of the exporting country. Animals must be kept, and semen must be collected, in compliance with the veterinary and sanitary requirements currently in force. Boars supplying sperm for export must not be vaccinated against classical swine fever. Boars must be kept at the AI centres for six months before collection of sperm, and must not be used for natural insemination during this period. Boars must not have been fed on feedstuffs produced using genetically modified additives or other genetically modified products. Semen must be free of pathogenic and toxic micro-organisms. Compliance with these veterinary and sanitary requirements must be certified by a veterinary certificate, signed by the state veterinary inspector of the exporting country, and drawn up in the language of the country of origin and in Russian. The veterinary certificate must contain the date and the results of diagnostic examinations. Semen destined for export must be packed and transported in special containers (vessels) filled with liquid nitrogen. Dispatch of semen to the Russian Federation is possible only after authorization issued to the importer by the Veterinary Department of the Ministry of Agriculture and Food.

Source: Legal Questionnaire (2003)

Some Country Reports mention the possibility of preventing the import of semen for ecological reasons. CR Algeria (2003) indicates that in certain cases the government can exercise its regulatory powers to ensure that inappropriate exotic semen is not imported or promoted to the detriment of local breeds that are better adapted to local conditions and the production objectives of small producers. CR Ecuador (2003) mentions that improved seeds, animals, technologies and equipment can be freely imported if they are not deemed harmful to local ecosystems.[125] Colombia has a constitutional regulation stating that "the state will regulate the entry and exit of genetic resources from the country, and their utilization, in accordance with national interests". [126]

CR Burkina Faso (2003) mentions the country's participation in a number of regional agreements relating to the management, utilization and exchange of genetic material, but indicates that these have not yet been implemented.

Import and Export of live animals

Controls on the international exchange of livestock are of great importance for the control of livestock disease. The introduction of diseases across a country's borders can have severe consequences for the livestock sector. CR Kenya (2004) for example, mentions that cross-border movement of livestock has caused the re-introduction of some previously eradicated notifiable diseases, which has led to the loss of disease-free zones in the country and the loss of external markets. Zoosanitary regulations are, however, significant barriers to the international exchange of AnGR. Instruments mentioned in the Country Reports include the definition of health standards for the import of live animals, requirements related to the animal health status of exporting countries, and quarantine requirements for imported animals.

Some countries indicate zoosanitary regulations for both import and export of live animals in general – for example, Mali[127], or for specific species – for example, Myanmar[128] (pigs, horses, sheep, goats, and cattle and buffaloes). Conversely, some countries indicate zoosanitary requirements and control for the import of live animals only. [129] See Section E: 3.2 for a discussion of EU laws covering health-related restrictions on trade in livestock and livestock products.

Quarantine measures are mentioned by many countries. Provisions for further quarantine measures to be applied in the case of disease epidemics are also often mentioned (see below). Some countries have

[125] Law of Agricultural Development the codification of which was published in the Official Register No. 55 of 30 April 1997
[126] Political Constitution of Colombia, 1991, Article 81 (CR Colombia, 2003)
[127] Decree 372/P-RM regulating sanitary control of animals on the territory of the Republic of Mali (Legal Questionnaire, 2003)
[128] In the case of pigs: Regulation for importation and exportation of breeding swine into Myanmar, 2003; similar laws for the other species were also passed in 2002 (FAOLEX)
[129] Kiribati's Importation of Animals Regulation, 1965 (FAOLEX); Palau's Plant and Animal Control – Chapter 20 of Title 25 of the Palau National Code, 1966 (FAOLEX)

instruments in place related to the import of animals from countries of regions particularly affected by animal health problems. Botswana's, Diseases of Animals Act 1977, for example, allows the prohibition of the import of animals from areas that are known to be affected by major diseases (CR Botswana, 2003). Other examples include El Salvador's legislation prohibiting the import of animals from countries affected by FMD[130] and Cape Verde's legislation prohibiting bovine imports from areas infected by BSE[131].

There are countries that have regulations regarding import and export of breeding animals. Chad, for example, prohibits the export for slaughter of female animals of breeding age.[132] CR China (2003) notes that the country's Ministry of Agriculture formulated an Administrative Regulation on Exportation of Breeding Animals during the 1980s, which was updated and adjusted in 1993. Examples from Europe include Hungary which reports regulations covering exports and imports (E-mail Consultation Hungary, 2005), and Germany[133] which reports legislation regulating the import of breeding animals. Ecuador's Law on Agricultural Development (1997) enables the import of breeding animals deemed unsuitable for local ecosystems to be restricted (CR Ecuador, 2003).

Livestock movement internal and regional

Livestock movement is one issue usually covered by legislation related to animal health. In countries where risks of disease outbreaks are high, separate laws tend to be adopted setting out strict rules on stock movement within the country and measures to enforce their observation (FAO, 2005).

Several countries indicate specific requirements related to livestock shows. CR Mozambique (2005), for example, reports provisions related to transportation to and from cattle shows. Similarly, in the United Kingdom, the Animal Gatherings (England) Order of 2003 specifies the zoosanitary measures that have to be included when organizing events such as shows or markets (Legal Questionnaire, 2003). In Japan, a health certificate is required for livestock to cross the border of a province (E-mail Consultation Japan, 2005). In the event of a disease epidemic, stricter regulations are implemented. Several countries have regulations regarding the welfare of transported live animals. One example is India (Box 64).

Box 64
India – rules for transportation

The rules provide for the transportation of poultry and pigs by rail, road or plane. Containers must be properly fitted for transportation – providing shelter from sun, heat, rain or cold, and allowing poultry and pigs to be comfortable during the journey. A table details the rules regarding the containers and the timing of journeys according to the size and age group of the animals. Vaccination and other health requisites are listed.

Source: FAOLEX

African countries where pastoralist production systems are widespread have adopted the use of transhumance certificates at both national and regional levels.

Box 65
West Africa – pastoralist crossing borders

Decision A/DEC.5/10/98, taken in Abuja in 1998 by the heads of state and government of the Economic Community of West African States (ECOWAS) relates to the use of transhumance certificates by mobile pastoralists within Member States. In Nigeria, efforts have been made to, *inter alia*, stipulate conditions for movement of nomadic livestock, i.e. their arrival to and departure from Nigeria.

Source: E-mail Consultation Nigeria (2005)

[130] Accord No. 54 – 2001. Prohibiting the import of bovine, ovine , caprine and porcine livestock and other cloven-hoofed species from countries affected by foot-and-mouth disease (FAOLEX)
[131] Order No. 10/2001 (FAOLEX)
[132] Decree No. 138 bis /PR/MEHP/88 regulating the unlimited export of and livestock products with the exception of reproductive females (CR Chad, 2003)
[133] Animal Breeding Import Ordinance (Legal Questionnaire, 2003)

Table 95
Instruments regulating livestock movements and import and export of live animals and livestock products

Legislation on Trade	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Import (Health standards)	2	2 (1)	4 (3)	8 (5)	5	6 (4)	(1)
Export	3	1		3	3		
Products	4			2		1	
Number of CRs	42	7	11	39	25	22	2

[n] = policies or legal basis unclear.

Instruments related to animal health

The number of countries that have developed and implemented legislation related to animal health is larger than in any other field (see previous subchapter for further discussion of measures related to animal movement and trade). Animals' health status has enormous impact on individual performance, on the production output and efficiency of the livestock sector, and on trade in products of animal origin. Most countries report some regulation (or at least institutions or programmes) related to animal health. However, some countries explicitly state that they do not yet have adequate regulation in place. Some of these countries mention the difficulties that they face in generating the necessary political will to ensure adequate regulation. Specific reference to the management of AnGR within national-level animal health legislation is rare in most parts of the world.

Legislation in this field may address disease surveillance and reporting, vaccination or vector control programmes, emergency measures to be taken in the event of epidemics, food hygiene and traceability of livestock products, inspection of livestock holdings and food processing establishments, production of livestock feed and veterinary products, and regulation of the qualifications, competences and duties of the veterinary profession. A country may have broad laws that regulate many aspects of animal health (Box 66), or there may be specific legislation related to a particular aspect of animal health or to a specific disease.

Table 96
Regulations in the field of animal health

Types of measures	Africa	Near & Middle East	Southwest Pacific	Europe & the Caucasus	Asia	Latin America & the Caribbean	North America
Legislation or policy in place	23 [2]	4 [2]	10	32 [1]	18 [4]	13 [1]	1
Vet. Services	8 [4]	2	0	10 [9]	7 [6]	0	
Epidemics general	0	1	3	5	3	1	
Epidemics specific	5	0	1	9	5	7	
Number of CRs	42	7	11	39	25	22	2

[n] = policies

It can probably be assumed that nearly every country has some laws on animal health in place. Differences exist with regard to the comprehensiveness of the legal provision, and whether the issue is handled within a regional-level framework.

Box 66
The Islamic Republic of Iran's Act of National Veterinary System (1971)

The act encompasses overall sanitary regulations, and regulates quarantine measures and transboundary movement of animals. The act also covers the following measures:
– prevention and control of animal diseases;
– hygiene certificates for animals and animal products for export;
– hygienic supervision of pastures, watering places, stables and other breeding establishments;
– monitoring of feed plants, slaughterhouses and processing units; and
– control of the production, import, export and marketing of various biological materials (e.g. drugs, vaccines and serums).

Source: CR Islamic Republic of Iran (2004)

Measures to be implemented in the event of epidemics

A number of countries report general legislation outlining response measures to be taken in the event of an epidemic. One such example is Denmark's Infectious Animal Diseases Control Act[134] (Legal Questionnaire, 2003). Legislation of this type may specify a list of notifiable diseases. Responses to epidemics may include the declaration and designation of epidemic-free zones and establishments – countries reporting such legislation include Viet Nam[135] and Zambia[136]. Eradication and control zones may be declared – countries reporting such legislation include El Salvador,[137] Australia[138] and the United Kingdom[139]. Uruguay, in its efforts to combat scabies in sheep obliges farmers to declare outbreaks or even the suspicion of an outbreak, and to contribute to the control of the disease[140].

Measures may include quarantine – examples include Zambia's Livestock Diseases Act (Legal Questionnaire, 2003). There may also be regulations regarding the disposal of infected animals – countries reporting such measures include Malawi[141], Zambia[142], the Netherlands[143] and Chile[144]. There may be payment of compensation for losses – reported, for example, by Estonia[145] and Switzerland[146]. Strategies to safeguard valuable AnGR in the event of eradication measures are rare, but have begun to be put in place in Europe for some diseases (see Section E: 3.2).

Regional cooperation

There tends to be a greater amount of regional or bilateral cooperation in the field of animal health than in other areas of AnGR-related legislation. Reported examples of cooperation agreements between neighbouring states, include those existing between Egypt and Algeria,[147] Turkey and Kazakhstan,[148] members of the Commonwealth of Independent States,[149] and Lusophone countries in

[134] Other reported examples include Australia, China, Costa Rica, Ecuador, El Salvador, Estonia, Fiji, Germany, Guatemala, Honduras, Iraq, Ireland, Jamaica,the Philippines, the Republic of Korea, Serbia and Montenegro, Switzerland, the United Kingdom, Vanuatu.
[135] Regulation on animal epidemic-free zones and establishments 2002 (FAOLEX)
[136] Cattle Cleansing Act of 1930 amended 1994 (Legal Questionnaire, 2003)
[137] Accord 194, declaring the geographical areas of the departments Usulután, San Miguel, Morazán and La Unión as control and erradication zones for bovine tuberculosis and brucellosis (CR El Salvador, 2003)
[138] Animal Health Act, 1995 (Legal Questionnaire, 2003)
[139] Diseases of Poultry (England) Order, 2003 (S.I. No. 1078 of 2003); Disease Control (England) Order, 2003 (S.I. No. 1729 of 2003) (Legal Questionnaire, 2003)
[140] Law No. 16.339 – declaring sheep scab a plague and making efforts to erradicate it compulsory (FAOLEX)
[141] Control and Diseases of Animals Act 2000 (Legal Questionnaire, 2003)
[142] Stock Diseases Act 1963 (amended 1994) (Legal Questionnaire, 2003)
[143] Decree No. 403 of 2001 to amend the Decree implementing provisions of the Animal Destruction Act, 16 July 2001 (Legal Questionnaire, 2003)
[144] Ley Nº 18.617 – norms for compensation for the slaughter of animals for the control of foot-and-mouth disease (Legal Questionnaire, 2003)
[145] Infectious Animal Disease Control Act, 16 June 1999 (Legal Questionnaire, 2003)
[146] Law on Epizootics, 1966 (amended. 2002) (Legal Questionnaire, 2003)
[147] Algeria: Official Gazette No. 14, 5 April 2001 (FAOLEX)
[148] Agreement between the Government of Kazakhstan and the Government of Turkey on cooperation in the sphere of animal health, 1995 (FAOLEX)
[149] Russian Federation, Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Uzbekistan, Ukraine; Agreement on cooperation of CIS member-states in the veterinary sphere (FAOLEX)

Africa.[150] There are also examples of bilateral international cooperation agreements between more distant countries – for example between Argentina and Hungary[151].

Institutions and animal health services

A number of countries report legislation related to institutional aspects of the delivery of veterinary services. There may be laws defining the roles, responsibilities and obligations of veterinarians. These measures may include licensing requirements for veterinary practice – an example being reported by Kazakhstan[152], or define the duties and powers[153], or responsibilities and obligations of veterinarians[154]. CR India (2004) reports the existence of veterinary councils established by a Veterinary Council Act; similar measures are reported from Nepal[155].

A number of countries report legislation defining their animal health systems. Examples include the Act of Veterinary System mentioned in CR Islamic Republic of Iran (2004), and the Russian Federation's Federal Law on Veterinary Service, which involves a scheme for state veterinary inspection of collective farms, state agricultural enterprises, and big livestock farms and complexes (Legal Questionnaire, 2003). Some countries have decentralized institutions – Peru, for example, reports local committees for animal health (CR Peru, 2004). Brazil reports regional Animal Health Inspectorates within the Ministry of Agriculture to carry out control of animal health at regional level.[156]

4.5 Conclusions

The analysis presented above clearly indicates that AnGR management is a complex matter, comprising a wide range of technical, policy and logistical operations. Many policy areas are involved – including agricultural and rural development, animal health, environmental and landscape conservation, culture, trade, research and education. Cooperation between many diverse stakeholders is required.

The decline of traditional livestock production systems is significant threat to many livestock breeds. Legislative and policy measures that, for whatever motivation, seek to support this type of production are potentially of importance to the maintenance of AnGR diversity. Countries in industrialized parts of the world are increasingly concerned about the conservation of rural environments and landscapes. There is a trend towards the introduction of regulations and policies aimed at the promotion of extensive farming practices – which tend to require breeds that are well adapted to local conditions. Conversely, in developing countries, food security and poverty alleviation are key objectives. Although there is often considerable focus on promoting intensive production, a number of countries, particularly in Africa, report measures to regulate and support the sustainability of extensive grazing systems. Given the unique adaptive traits of many dryland breeds and the many pressures faced by these production systems, effective policy and legislation in this field are of great importance. Nonetheless, devising measures that are appropriate to the needs of pastoral groups, who are often politically marginalized, remains a major challenge. Other reported legislative measures that have been put in place to support small-scale livestock production include those related to the provision of credit and the establishment of producer organizations and cooperative groups.

The implementation of specific measures aimed at the conservation of AnGR is greatly dependent on the economic means of the country in question, and this is reflected in the greater density of legislation and policy in the more developed areas of the world. However, it is also clear that the importance of

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[150] Angola, Cape Verde, Guinea-Bissau, Mozambique, Sao Tome and Principe; Guinea-Bissau's Decree No 351/73, Boletin Official No. 89 (FAOLEX)

[151] Governmental Decree No. 4 of 2002 ratifying and publishing the Agreement stipulated on 10 December 1999 in Budapest between Hungary and Argentina on animal health (FAOLEX)

[152] Ministerial Decree No. 1972 of 1997 regarding the validation for the regulation on licensing of veterinary practice, 20 August 1997 (Legal Questionnaire, 2003)

[153] Georgia's Veterinary Act (CR Georgia, 2004)

[154] Estonia's Veterinary Activities Organization Act, 1999 (Legal Questionnaire, 2003)

[155] Nepal's Veterinary Council Act, 2055 (1999) (FAOLEX)

[156] Law No. 1.052 creating the Animal Health Inspectorate within the Ministry of Agriculture (1950) (Legal Questionnaire, 2003)

sustainable use and conservation of AnGR has in many cases not been adequately accommodated in the development of legal and policy frameworks at the national level. Inventory and registration systems, for example, are of great importance for the planning and implementation of conservation measures, but many countries report that policy and legislation in this field remains weak. A further step that can facilitate the administration of conservation schemes is the legal definition of criteria for the inclusion of breeds in such programmes, but measures of this type remain rare.

Where regulations related to conservation exist, they are often isolated, and not integrated into a strategy which takes account of the cross-cutting character of the issue. For example, measures aimed at increasing food security often focus almost exclusively on high-output breeds, without an adequate assessment of the potential contribution of local breeds, and without a strategy for their conservation. Another example is the field of animal health, which is the most highly regulated aspect of livestock management on a global scale. While effective disease control is essential for the use and development of AnGR, restrictions on movement and trade can present problems for AnGR management. Slaughter policies implemented in the event of epidemics pose a potential threat to rare breed populations. It is a matter of concern that throughout most of the world, very little attention has been paid to this threat in the development of legal frameworks and policies for disease control.

The extent to which legal frameworks for the management of AnGR have been put in place at the national level varies greatly. Many countries in Europe have extensive legislation. Conversely, in other regions, in particular in Africa, countries generally seem to rely on policy measures, which may be backed by legal mandates for the implementing institutions. This contrast raises the question of whether the establishment of elaborate legislative instruments regulating AnGR management is the most appropriate objective in developing countries. In some cases, countries clearly indicate that improved legislation is considered necessary. CR Kenya (2004), for example, states that "a suitable legal framework is ... required for operationalization of the [existing] policies. Once the right policies and legislation have been formulated, it will be necessary to review and revise them regularly to make them respond to the changes that occur with time." Some countries are increasingly relying on market mechanisms or on private institutions for specific aspects of AnGR management, but have only limited legislation in place to regulate the field. It is possible that this could give rise to problems with regards to public goods aspects of AnGR management, and a close evaluation of the need for improved regulation is likely to be necessary. The decision, as to the appropriate solution for a given situation will depend on the political and legislative culture of the country in question, and on the structures available for implementation. In some circumstances, sound policy decisions and strategies, complemented by a clear legal definition of the competences and duties of institutions, and a well-organized monitoring and evaluation system, might be more effective than an elaborate legal framework.

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