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COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Item 3 of the Provisional Agenda

INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Eighth Session

Rome, 26-28 November 2014

DRAFT *SECOND REPORT ON THE STATE OF THE WORLD'S ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE*

Part 3

Status of preparation

All parts of *The second report on the world's animal genetic resources for food and agriculture* (Second Report) have been drafted. However, Part 4 – State of the art in the management of animal genetic resources – is at an early stage of drafting and will thus not be made available to the Working Group. While a number of sections of the Second Report have been reviewed by FAO and external experts, these sections still need to be revised based on the comments received. Review of the remaining sections remains to be arranged. The whole report needs to be further edited to ensure internal consistency and improve readability. The acknowledgements, preface, executive summary and list of abbreviations and acronyms still need to be prepared. It is foreseen that a full draft of the Second Report will be ready in March 2015.

This document is printed in limited numbers to minimize the environmental impact of FAO's processes and contribute to climate neutrality. Delegates and observers are kindly requested to bring their copies to meetings and to avoid asking for additional copies. Documents for this meeting are available on the Internet at http://www.fao.org/Ag/AGAInfo/programmes/en/genetics/angrvent.html

Part 3

THE STATE OF CAPACITIES

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Introduction

This part of the report presents an analysis of capacities in the management of animal genetic resources for food and agriculture (AnGR), based on the information provided in the country reports. In contrast to the country reporting process for the first report on *The State of the World's Animal Genetic Resources for Food and Agriculture*, the country reports were prepared using a standard questionnaire. One hundred and twenty-eight reports were submitted using the questionnaire. Therefore, except where otherwise stated, the analysis is based on a self-selecting sample of 128 countries. The country coverage, including the possibility that non-reporting countries may have lower levels of capacity than those that reported, needs to be borne in mind when interpreting the findings. The country-report questionnaire requested respondents to indicate the number of breeds present in their respective countries and to indicate how many are "locally adapted" and how many "exotic" (see Part 1 Section 2 for definitions). Unless otherwise stated, figures indicating the proportion of national breed populations subject to various types of management activity are based on this sample.

The analytical approach varies from section to section, according to the nature of the information provided in the country reports. The first section presents an analysis the state of human and institutional capacity in AnGR management. This is followed by sections describing the state of characterization, inventory and monitoring, breeding programmes, conservation programmes and the use of reproductive and molecular biotechnologies. The final section covers legal and policy frameworks affecting AnGR and their management. This section is divided into three major subsections, addressing frameworks at international, regional and national levels. This subsection on legal and policy frameworks at national level draws on responses to a survey conducted by FAO in 2013.

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CONTENTS

Part 3 THE STATE OF CAPACITIES

DRAFT - NOT FOR CITATION

DRAFT - NOT FOR CITATION

BOXES

DRAFT - NOT FOR CITATION

TABLES

DRAFT - NOT FOR CITATION

DRAFT - NOT FOR CITATION

DRAFT - NOT FOR CITATION

FIGURES

DRAFT - NOT FOR CITATION

DRAFT - NOT FOR CITATION

SECTION A: INSTITUTIONS AND STAKEHOLDERS

1. Introduction

The first report on *The State of the World's Animal Genetic Resources for Food and Agriculture* (first SoW-AnGR) (FAO, 2007a) concluded that in most parts of the world the institutional framework for animal genetic resources (AnGR) management was inadequate. Improvements in this field are targeted in the Global Plan of Action's Strategic Priority Area 4 – Policies, Institutions and Capacity-building (see Box 3A1). This section describes the state of human and institutional capacities in AnGR management at national, regional and international levels. The analysis is based largely on the country reports, reports from regional focal points and networks for AnGR management and reports from international organizations whose work is relevant to the implementation of the Global Plan of Action for Animal Genetic Resources (FAO, 2007b).

Box 3A1. Strategic priorities within Strategic Priority Area 4 of the Global Plan of Action for Animal Genetic Resources categorized by level of implementation (national, regional or international)

Strategic Priority Area 4: Policies, Institutions and Capacity-building

National level

SP 12 Establish or strengthen national institutions, including national focal points, for planning and implementing AnGR measures, for livestock sector development.

SP 13 Establish or strengthen national educational and research facilities.

SP 14 Strengthen national human capacity for characterization, inventory, and monitoring of trends and associated risks, for sustainable use and development, and for conservation.

SP 18 Raise national awareness of the roles and values of AnGR.

SP 20 Review and develop national policies and legal frameworks for AnGR.

Regional level

SP 17 Establish Regional Focal Points and strengthen international networks.

International level

SP 15 Establish or strengthen international information sharing, research and education

SP 16 Strengthen international cooperation to build capacities in developing countries and countries with economies in transition

SP 19 Raise regional and international awareness of the roles and values of AnGR

SP 21 Review and develop international policies and regulatory frameworks relevant to AnGR

SP 22 Coordinate the Commission's efforts on AnGR policy with other international forums

SP 23 Strengthen efforts to mobilize resources, including financial resources, for the conservation, sustain use and development of AnGR**.**

Note: SP = Strategic Priority; "the Commission" = the Commission on Genetic Resources for Food and Agriculture.

2. Institutional capacities at country level

2.1. Basic recommended institutional framework for animal genetic resources management

In adopting the Global Plan of Action, countries affirmed the need for effective national institutions to support the sustainable management of AnGR. The Global Plan of Action specifically calls for the establishment or strengthening of National Focal Points for the Management of Animal Genetic

Resources and for these bodies to strongly link to stakeholder networks. Recommendations for the development of institutional frameworks at national level were further elaborated in guidelines endorsed by the Commission on Genetic Resources for Food and Agriculture in 2011 (FAO, 2011a). The basic elements of this recommended framework are an officially nominated National Coordinator for the Management of Animal Genetic Resources, a National Focal Point (the National Coordinator and his or her support staff) supported by a multistakeholder National Advisory Committee (see Boxes 3A2 and 3A3). It is also recommended that each country develop a national strategy and action plan for AnGR as a vehicle for implementing the Global Plan of Action at national level (FAO, 2009).

As of July 2014, officially nominated national coordinators were in place in 173 countries (Figure 3A1), up from 144 in 2006 (FAO, 2006). A majority of National Coordinators are based within ministries responsible for agriculture or rural development. However a number work for research institutions, universities or other relevant organizations (Figure 3A3). National Advisory Committees were in place in 78 countries (Figure 3A2).

Box 3A2. Elements of the recommended national institutional framework for the management of animal genetic resources

National Coordinator for the Management of Animal Genetic Resources: the government-nominated person who coordinates the national implementation of the Global Plan of Action for Animal Genetic Resources and leads the development and operation of a national network of stakeholders. He or she is the contact person for communication with FAO on matters relating to the implementation of the Global Plan of Action for Animal Genetic Resources and with global and regional AnGR networks.

National Focal Point for the Management of Animal Genetic Resources (NFP): the National Coordinator for the Management of Animal Genetic Resources and his or her support staff within the institution responsible for coordinating activities concerning the management of AnGR.

National Advisory Committee: a multistakeholder body, incorporating both scientific and policy expertise, that provides guidance on the development of the national AnGR programme.

Source: FAO, 2011a.

Box 3A3. The role of the National Coordinator for the Management of Animal Genetic Resources

The recommended activities of National Coordinators include the following:

Policy development

- Facilitating and supporting the development and revision of policy and legal frameworks in the field of AnGR management, including national strategy and action plans for AnGR.
- Contributing to the development and revision of other relevant policy and legal instruments such as including national strategy and action plans on conservation and sustainable use of biological diversity and national livestock-development strategies.

Strengthening AnGR management

- Coordinating the implementation of the National Strategy and Action Plan for AnGR.
- Coordinating and supporting the planning, implementation, monitoring and evaluation of conservation, surveying and monitoring and breed development strategies.
- Coordinating the identification of research priorities in AnGR management.
- Coordinating the mobilization of financial and other resources to support implementation of the National Strategy and Action Plan for AnGR.

Communication and cooperation

- Facilitating communication on AnGR management between the National Focal Point for the Management of Animal Genetic Resources and relevant ministries and other national bodies such as the National Focal Point for the Convention on Biological Diversity.

- Developing and supporting national stakeholder networks in the AnGR sector.
- Communicating with FAO and with Regional Focal Points and National Focal points in other countries and cooperating in activities organized at regional and international levels.

Education and public awareness

- Raising awareness of AnGR issues via conferences, exhibitions, books, brochures, posters, the internet, television, radio and so on.

Global reporting

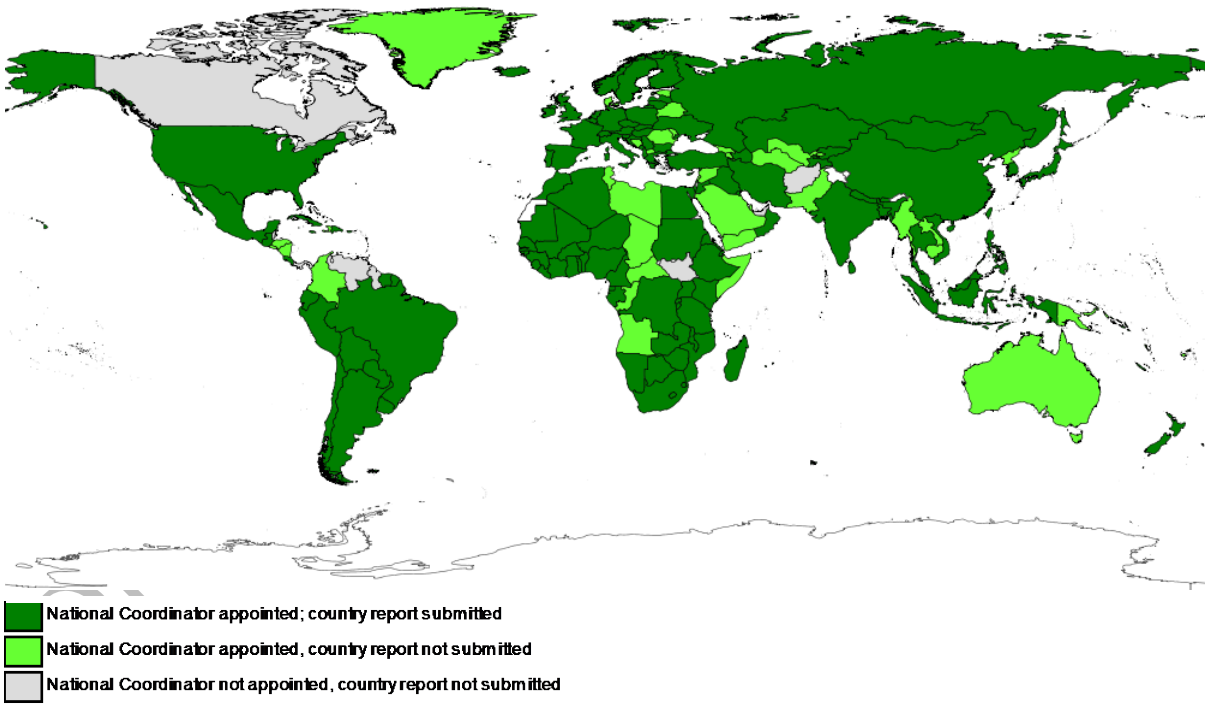
- Updating the national data in DAD-IS (or regional database if applicable) on a regular basis.
- coordinating progress reporting on the implementation of the Global Plan of Action for Animal Genetic Resources.

Intergovernmental processes

- Participating in country delegations to the sessions of the Intergovernmental Technical Working Group on AnGR, the Commission on Genetic Resources for Food and Agriculture and other relevant intergovernmental bodies.
- Contributing the development of country negotiating positions.
- Communicating with other National Coordinators to develop regional positions.
- Debriefing government officials following meetings and implementing actions recommended by intergovernmental bodies.

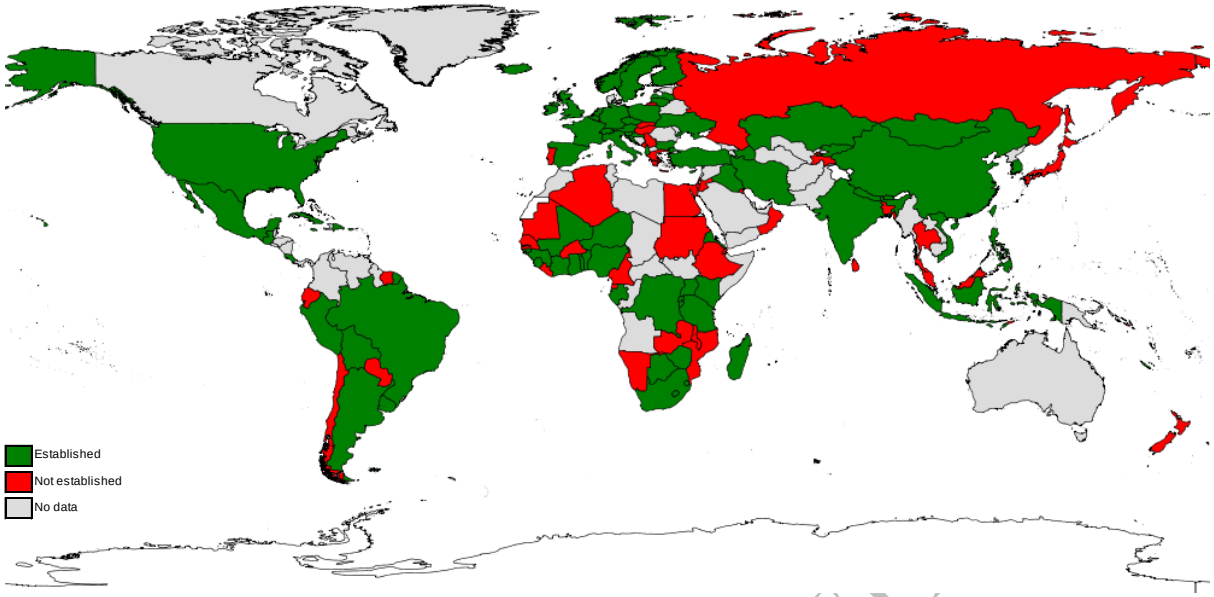
Source: FAO, 2011a.

Figure 3A1. Countries with National Coordinator for the Management of Animal Genetic Resources (as of July 2014) and that submitted country reports



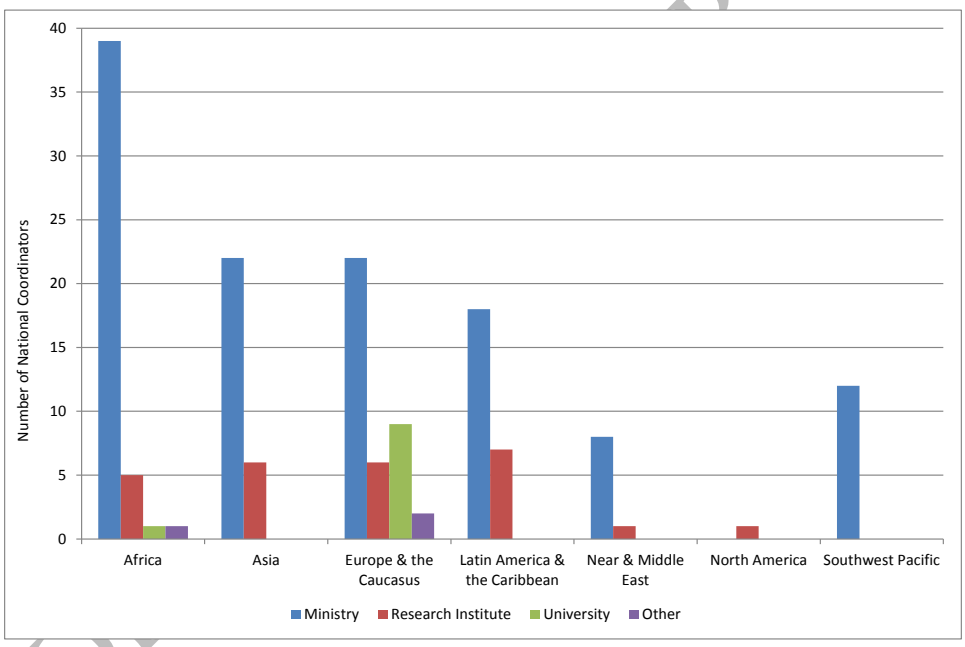
Note: The country report of Morocco was not prepared in the standardized format and thus could not be included in the analysis.

Figure 3A2. Status of National Advisory Committee for Animal Genetic Resources



Source: Country reports.

Figure 3A3. Employment affiliations of National Coordinators for the Management of Animal Genetic Resources



Source: DAD-IS (http://fao.org/DAD-IS, accessed in September 2014).

2.2. Country report analysis

The country-report questionnaire requested countries to provide a score (none, low, medium or high) for the state of their capacities and provisions in each of the following areas:

- education (the state of tertiary education in all areas of animal genetic resources management);
- research (the state of research in all areas of animal genetic resources management);
- awareness (the extent to which all stakeholders in agriculture, rural development and environmental management are aware of the roles and values of animal genetic resources);

- infrastructure (the extent to which the organizational and physical infrastructure needed to deliver services related to animal genetic resources management is in place);
- stakeholder participation (the extent to which individual stakeholders and stakeholder organizations, particularly livestock keepers and their organizations, are involved in and can influence collaborative animal genetic resources management activities at local and national levels);
- policies (the extent to which the country (i.e. national or regional government) has established policy initiatives, strategies, programmes or plans that promote the sustainable use, development and conservation of animal genetic resources);
- policy implementation (the extent to which the country's policy initiatives, strategies, programmes or plans promoting the sustainable use, development and conservation of animal genetic resources are being successfully implemented);
- laws (the extent to which the country has put in place a legal framework that is conducive to the sustainable use, development and conservation of animal genetic resources and that protects livestock breeders/owners' rights to manage animal genetic resources as they deem appropriate);
- implementation of laws (the extent to which the country's laws favourable to the sustainable use, development and conservation of animal genetic resources are being successfully implemented).

With regard to policies and laws, the questionnaire recognized that the type of framework required would vary from country to country, i.e. that elaborate frameworks are not necessarily required in all circumstances. In assigning their scores, countries were asked to focus on the extent to which their legal and policy measures are sufficient to ensure the sustainable use, development and conservation of animal genetic resources in their particular national circumstances. The responses are summarized region by region in Figure 3A4. Differences at subregional level are shown in Figures 3A5, 3A6 and 3A7. Detailed findings within each thematic area are shown in Figures 3A9, 3A10 and 3A11.

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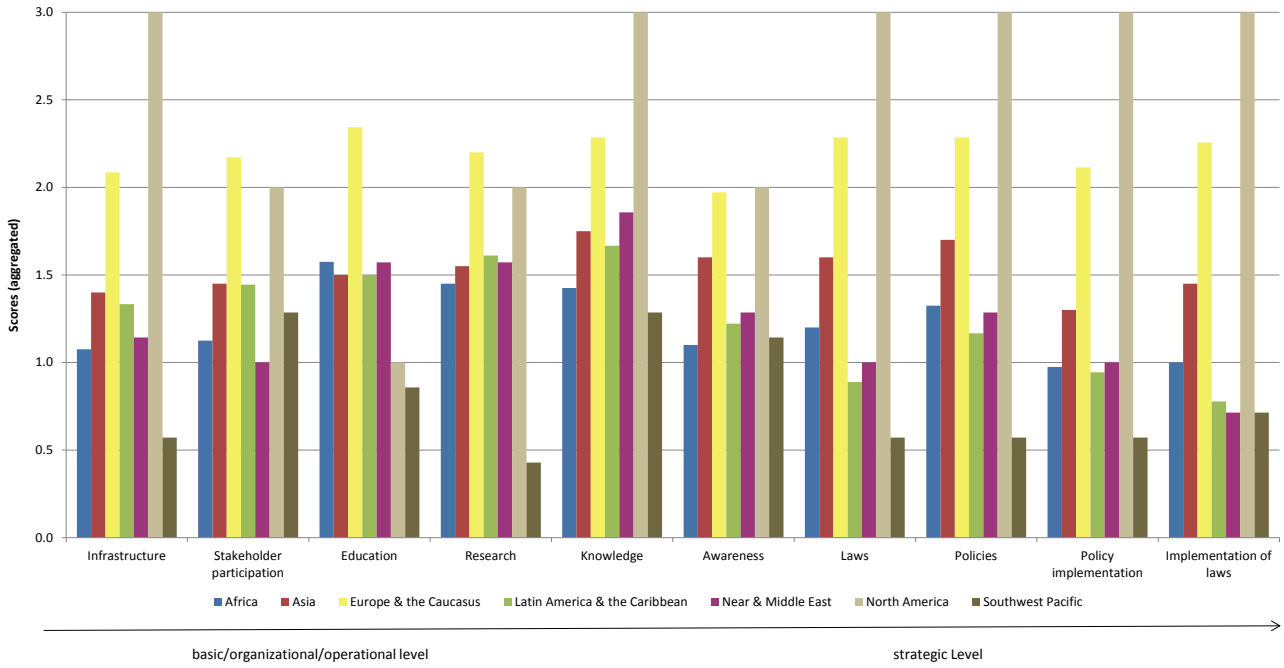
Figure 3A4. Overview of the state of institutions (regional breakdown)

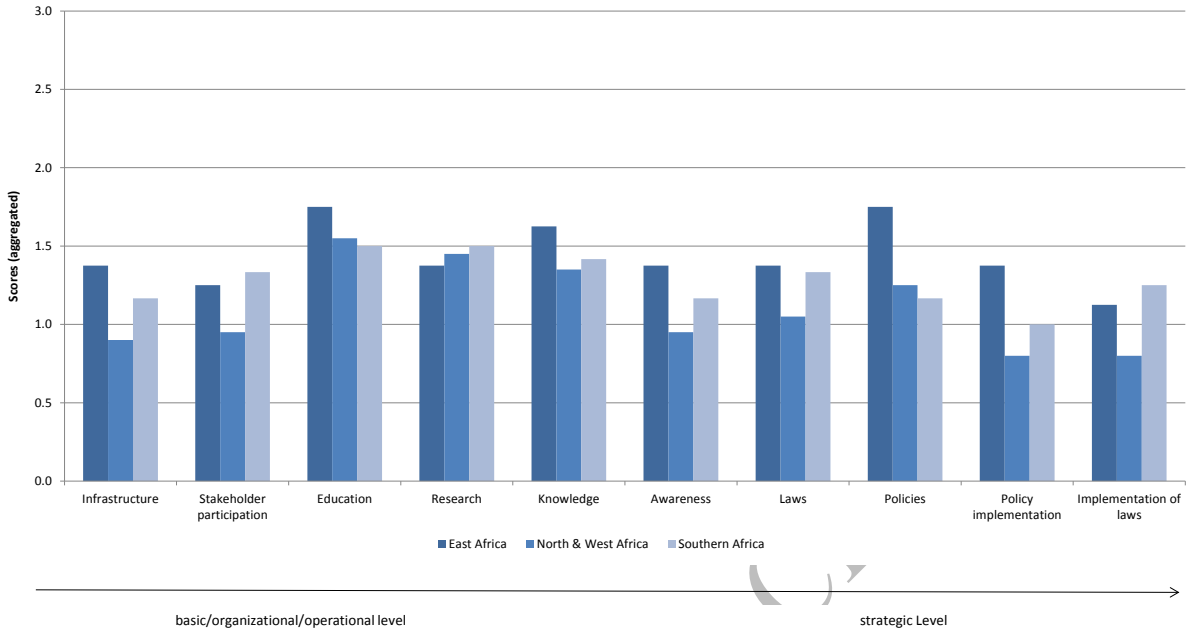


Note: Each country provided a score for the state of institutions in each area. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

The scores shown in Figure 3A4 indicate that in almost all aspects of the institutional framework for AnGR management, North America (represented in the country reporting by the United States of America) and Europe and the Caucasus have higher levels of capacity than other regions. Asia has medium to low levels of capacity (average scores between 1 and 2) across all the elements of

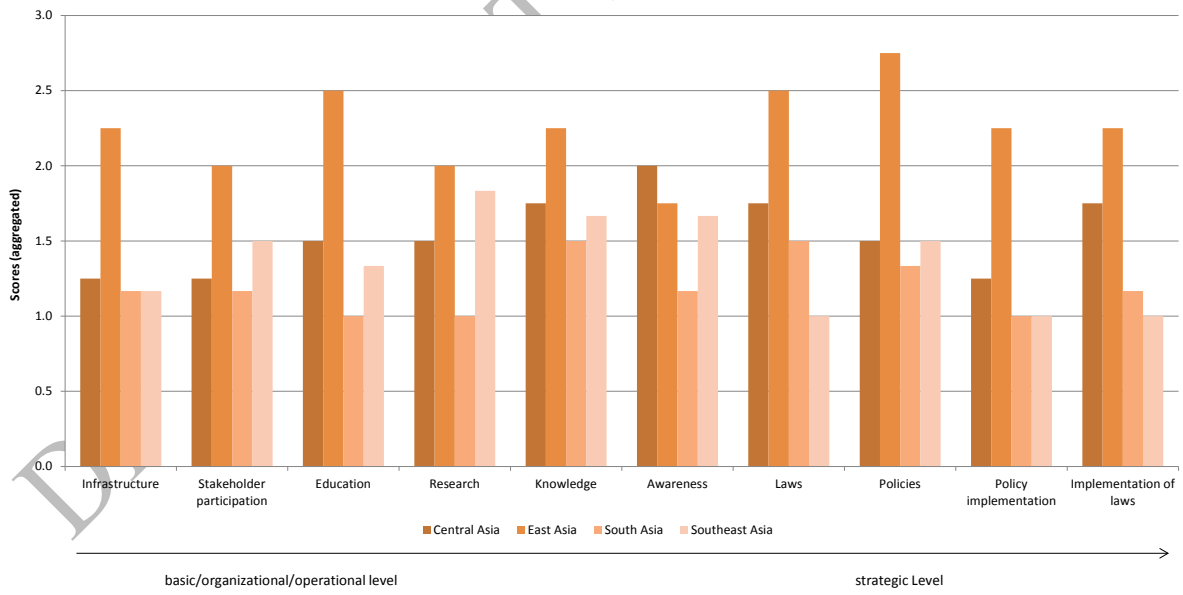
institutional capacity covered. In other developing regions, at least some elements of institutional capacity are at very low levels (average scores between 0 and 1).

Figure 3A5. State of institutions – subregional comparison within Africa



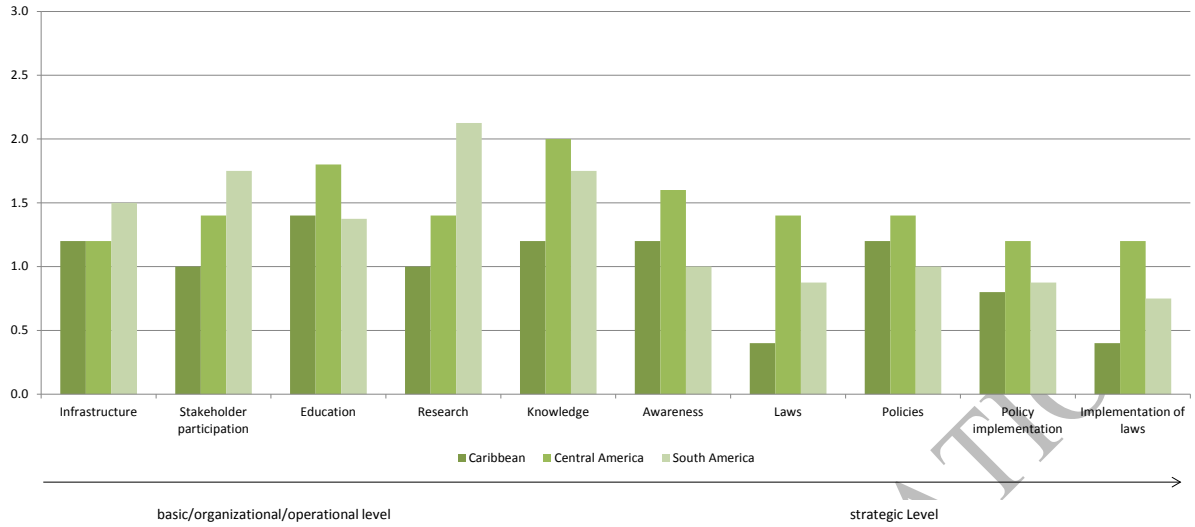
Note: Each country provided a score for the state of institutions in each area. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

Figure 3A6. State of institutions – subregional comparison within Asia



Note: Each country provided a score for the state of institutions in each area. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

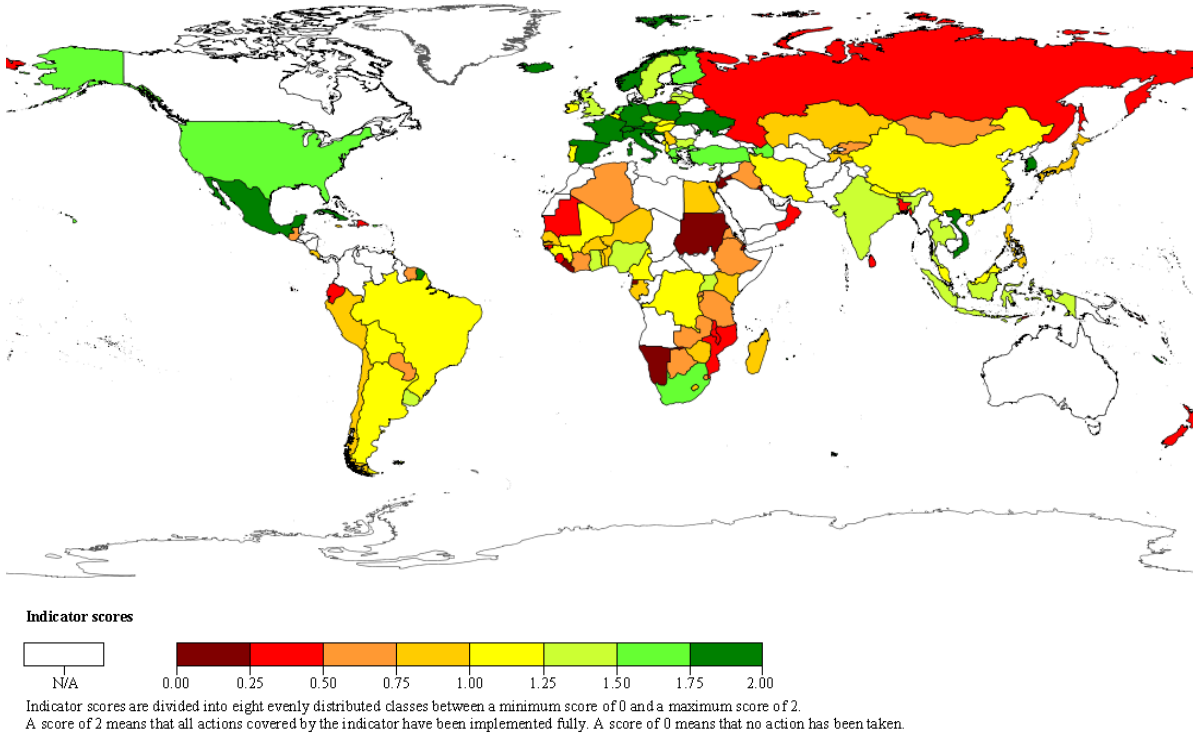
Figure 3A7. State of institutions – subregional comparison within Latin America and the Caribbean



Note: Each country provided a score for the state of institutions in each area. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

The country-report questionnaire also required responding countries to report on the progress they had made in implementing the various elements of the Global Plan of Action. These responses were used to calculate indicators for progress made at the level of strategic priority areas and individual strategic priorities (see Boxes [crossref] and [3A1]) (FAO, 2014). National-level indicators for Strategic Priority Area 4 (Policies, Institutions and Capacity-building) are shown in Figure 3A8.

Figure 3A8. National level indicators for the implementation of Strategic Priority Area 4 (Policies, Institutions and Capacity-building) of the Global Plan of Action for Animal Genetic Resources



Source: FAO (2014).

Infrastructure and stakeholder participation

Organized AnGR management activities that involve action at farm (or holding) level (e.g. *in situ* conservation) are dependent on the active involvement of livestock keepers. They will often also require the participation of a range of other stakeholders (suppliers of livestock services, processers of livestock products, veterinary authorities, research institutions, local government authorities, nature conservation agencies, tourism operators and so on) (FAO, 2010, 2013). Other activities, such as surveying and monitoring of population sizes, may not require such a high level of commitment on the part of livestock keepers, but are nonetheless dependent on their participation. Again, they are also likely to require the cooperation of a range of different stakeholders (FAO, 2011b). While circumstances will vary from country to country, a top-down approach in which little attention is paid to stakeholders' objectives and concerns – particularly those of livestock keepers – is unlikely to be effective as a means of promoting the sustainable management of AnGR.

Effective stakeholder participation in AnGR management is likely to depend on the existence of a degree of organizational infrastructure, whether in the form of stakeholder groups such as breeders' associations or in the form of mechanisms that facilitate the involvement of individual stakeholders (consultative and participatory planning processes, etc.). Various elements of AnGR management are also dependent on the availability of a certain level of physical and technical infrastructure (laboratory facilities to enable cryoconservation, transport infrastructure to facilitate service delivery and livestock-marketing initiatives, etc.).

The country reports indicate that in all regions apart from North America and Europe and the Caucasus, both stakeholder involvement and physical and organizational infrastructure remain at low to medium levels of development (Figure 3A9). Even in developed regions, it appears that provisions in these fields still need to be strengthened. In North America, for example, infrastructure is very well developed, but the level of stakeholder participation is reported only to be medium. Many developing countries report that a lack of government support and funding constrains efforts to improve stakeholder participation. Some examples of initiatives in this field are nonetheless reported in the country reports. For example, Uganda reports that livestock-keeper groups influence activities at local level and are gradually acquiring national recognition. The country is in the process of establishing a "Livestock Genetic Platform" via which stakeholders will be able to contribute to discussions on AnGR management.

Many countries, particularly in Africa, note that a lack of funding for infrastructure development is a problem. For example, the country report from the United Republic of Tanzania mentions poor road links to livestock-keeping areas. While European countries generally have well-developed infrastructure in place, some remote areas in this region remain poorly served by road networks. This can constrain surveying and monitoring activities, access to markets and the provision of veterinary services. The country report from Albania notes that in mountainous areas infrastructural developments associated with tourism have inadvertently allowed AnGR conservation to flourish.

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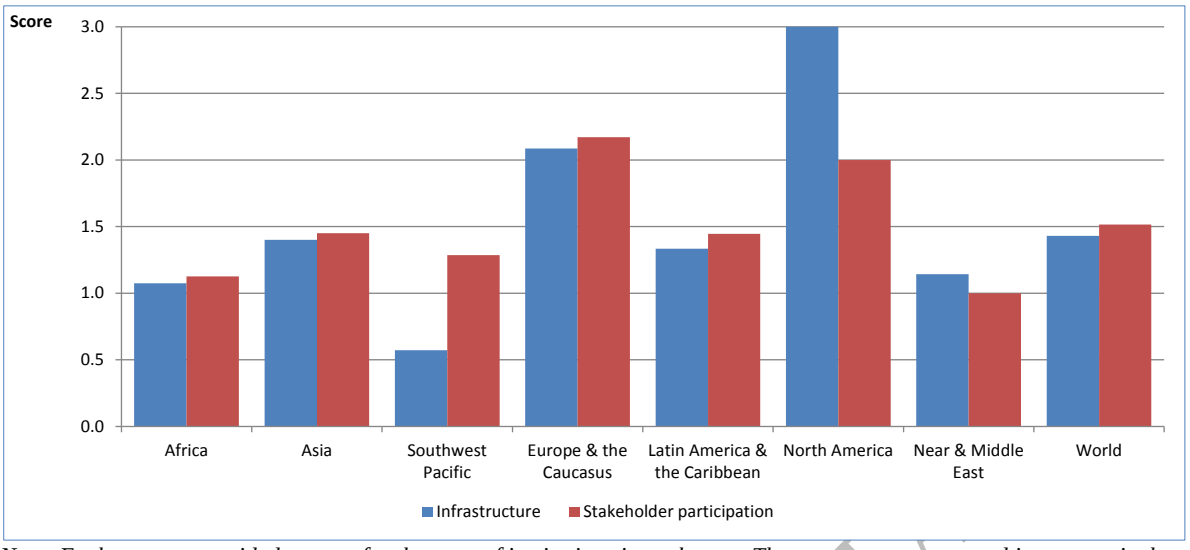
Figure 3A9. Institutional assessment – infrastructure and stakeholder participation at regional level



Note: Each country provided a score for the state of institutions in each area. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

Education, research and knowledge

A lack of knowledge of AnGR and their management can be a serious constraint to the sustainable use, development and conservation of these resources. Some country reports note specific constraints or problems that have arisen because of a lack of knowledge. Swaziland's report, for example, mentions that indigenous knowledge related to livestock keeping and the maintenance of AnGR diversity has not been documented and that this is a constraint to the development of breeding programmes and other AnGR management strategies. In Sri Lanka, lack of knowledge is reported to lead to the slaughter of valuable breeding animals and to indiscriminate cross-breeding. Inability to distinguish between breeds has reportedly led to the near extinction of some of the country's breeds such as the Kottukachchiya goat. The state of education, research and knowledge is summarized in Figure 3A10. As in most areas of AnGR management, the highest levels of provision and capacity are reported from the developed regions of the world, although levels differ markedly between countries even in these regions. In most developing regions, education, research and knowledge are at medium to low levels, with the Southwest Pacific reporting the lowest levels across all categories.

While a number of countries report various educational courses and training activities related to livestock production, relatively little information is provided on the state of education more specifically related to AnGR management, i.e. breeding (genetic improvement), conservation, characterization, etc. Educational initiatives targeting AnGR management as a distinct topic appear to be restricted mainly to Europe and not to be very widespread. The livestock production study programme of University of Montenegro's Biotechnical Faculty now includes a course in "Animal genetic resources (sustainable use and conservation)". The country report from the Netherlands notes that in addition to university-level programmes, biodiversity and genetic resources are also included in the curriculum at primary and secondary school levels.

AnGR-related research activity is widely reported from all regions of the world. Nonetheless, many barriers to effective research efforts remain to be overcome, especially in developing countries. For example, the country report from Kyrgyzstan notes that a lack of funding and resources (laboratories and technical knowledge) and the absence of governmental support has reduced research capacity. A lack of young scientists entering the field is noted as constraint to research in some country reports (e.g. Barbados and Liberia).

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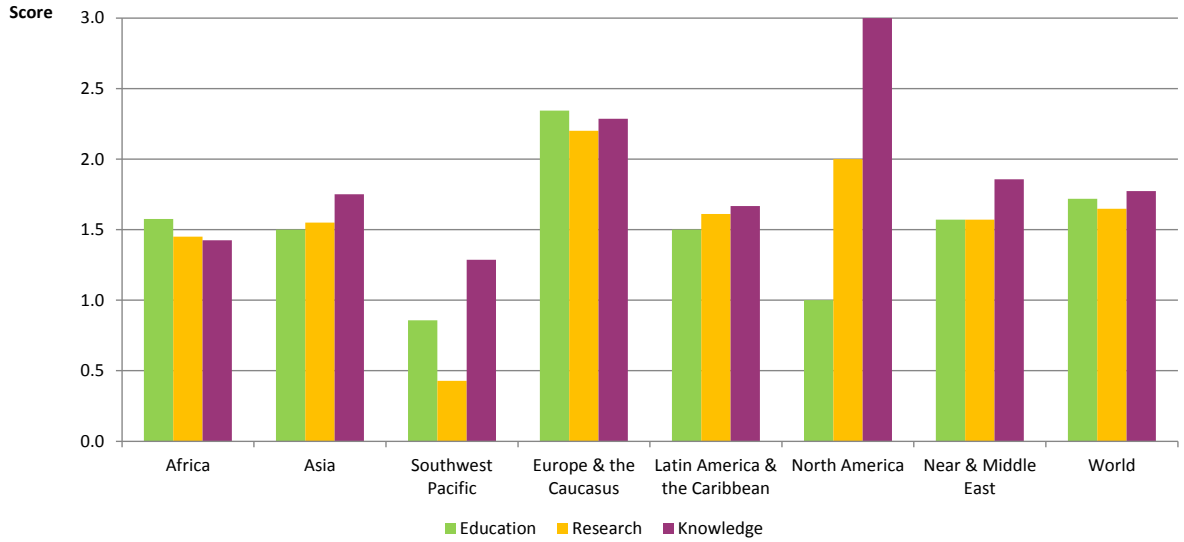
Figure 3A10. Institutional assessment – education, research and knowledge at regional level

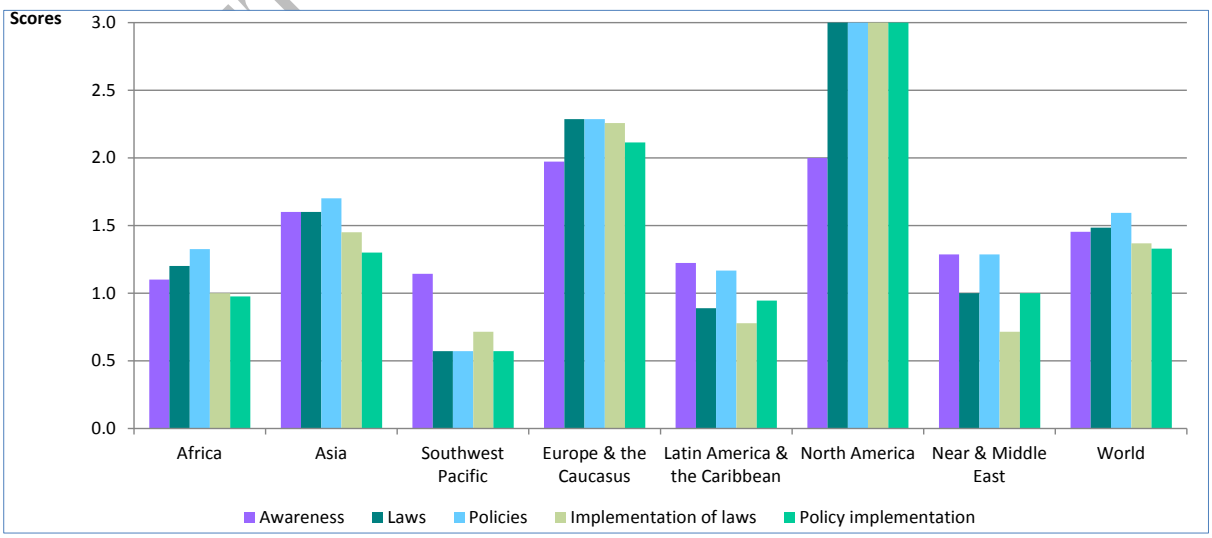


Note: Each country provided a score for the state of institutions in each area. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

State of awareness, policies and policy development, and laws and their degree of implementation

As noted in the first SoW-AnGR, awareness of the roles and values of AnGR among policy-makers is an important prerequisite for the development of appropriate institutions for their management. Awareness among the general public may also help to push the issue up the political agenda. Awareness among livestock keepers and development practitioners should lead to more sustainable approaches to AnGR management (providing such approaches are not constrained by other factors such as a lack of resources). Policies and laws can have a major influence on AnGR management. However, the specific types of instruments and the levels of intervention required will depend on the specific circumstances in the respective country. Legal and policy frameworks are discussed in detail in Section [crossref]. Country-report responses related to the state of awareness, laws, policies, implementation of laws and policy implementation are summarized in Figure 3A11.

Figure 3A11. Institutional assessment – state of policy development at regional level



Note: Each country provided a score for the state of institutions in each area. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

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The country reports indicate that in all regions there is a need to increase awareness of the roles and values of AnGR. Awareness of the significance of locally adapted breeds and the need to conserve those that are at risk of extinction may possibly be even lower than suggested by the data presented in Figure 3A11. For example, the country report from Germany notes that awareness is high only in relation to economically important breeds and that there is significantly less awareness of issues related to the management of breeds that are at risk of extinction. Nonetheless, a certain basic awareness of the significance of sustainably managing AnGR is apparently widespread at governmental level given the very large number of countries that have appointed National Coordinators for the Management of AnGR (see above).

Legal and policy frameworks are well developed in North America and Europe and the Caucasus, but less so in other regions. It should be recalled (see above) that high scores do not necessarily indicate elaborate legal or policy measures in the field of AnGR management. They indicate that existing legal and policy frameworks are appropriate to the needs of the respective country. For example, the United States of America reports a relatively non-interventionist approach in many AnGR-related fields of policy and legislation (see Section [crossref]), but that this creates a conducive framework for effective AnGR management. The state of implementation of laws and policies is at a high level in North America, and a medium to high level in Europe and the Caucasus. However, in other regions there appear to be major weaknesses in implementation. It is possible that the low scores are in part accounted for by a lack of any laws or policies to implement, but in most regions the level of implementation lags behind the level of official or "on paper" provision.

A number of different awareness raising activities (exhibitions at agricultural shows, television programmes on AnGR-related topics, etc.) are mentioned in the country reports. There are some indications that these have led to positive outcomes in terms of AnGR management. The country report from South Africa, for example, notes that intensified awareness-raising efforts targeting the "developing-farmer" and communal sectors have led to additional breeds, including the Zulu sheep, Tankwa goat and Afrikaner cattle, being characterized and conserved.

Integration of the management of animal genetic resources with the management of plant, forestry and aquatic genetic resources

In view of growing interest in managing the various elements of biodiversity for food and agriculture in a more integrated way, the country-report questionnaire included a subsection devoted to this topic. Countries were requested to provide information on the extent to which AnGR management is integrated with the management of plant, forest and aquatic genetic resources for food and agriculture by providing a score (none, limited or extensive) for the extent of collaboration in various aspects of genetic resources management. They were also requested to describe the nature of any collaboration reported and, if relevant, to describe any benefits obtained by pursuing a collaborative approach. The results of the scoring exercise are summarized in Table 3A1.

The average scores for the extent of collaboration between the subsectors of genetic resources management are rather low. However, there is a lot of variation between countries in terms of the levels of collaboration reported. While 20 percent of countries reported no collaboration in any of the areas of management considered, there were a number of reports of "extensive" integration. In the case of "joint national strategies or action plans" (some countries specified that they were referring legal instruments), 16 percent of countries indicated an extensive level of integration. There were also some reports of integrated activities in fields such as marketing. For example, the country report from Poland mentions the "Kurpie model", an NGO initiative to promote agricultural biodiversity, under which indigenous livestock breeds and plant varieties have been reintroduced and promoted for use in organic agriculture and sustainable development in the northeastern part of the country. Plant and animal products from the scheme are jointly marketed in shops in the capital city.

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Table 3A1. Reported extent of collaboration in the management the various subsectors of genetic resources for food and agriculture

Regions and subregions	Number of countries	Joint national strategies or action plans	Characterization	Genetic improvement	Product development and/or marketing	Conservation strategies, programmes or projects	Awareness-raising	Training activities and education	Mobilization of resources
Africa	40	0.6	0.7	0.4	0.5	0.6	0.6	0.6	0.4
East Africa	8	0.4	0.8	0.3	0.3	0.5	0.3	0.5	0.3
North and West Africa	20	0.6	0.7	0.4	0.5	0.6	0.6	0.6	0.4
Southern Africa	12	0.8	0.5	0.6	0.6	0.6	0.7	0.5	0.4
Asia	20	1.0	0.6	0.5	0.4	0.5	0.6	0.5	0.5
Central Asia	4	0.8	0.5	0.8	0.2	0.0	0.0	0.2	0.0
East Asia	4	1.0	0.6	0.6	0.6	1.0	1.5	0.4	0.8
South Asia	6	0.7	0.5	0.3	0.2	0.7	0.7	0.8	0.3
Southeast Asia	6	1.3	0.8	0.6	0.6	0.4	0.4	0.4	0.7
Southwest Pacific	7	0.4	0.3	0.4	0.3	0.3	0.4	0.1	0.1
Europe and the Caucasus	35	1.0	0.5	0.3	0.5	0.7	0.9	0.7	0.7
Latin America & the Caribbean	18	0.8	0.3	0.4	0.3	0.6	0.9	0.7	0.6
Caribbean	5	0.2	0.0	0.0	0.0	0.0	0.4	0.4	0.0
Central America	5	1.0	0.4	0.8	0.6	0.6	0.8	0.6	0.8
South America	8	1.0	0.5	0.4	0.4	0.9	1.3	0.9	0.9
North America	1	0.0	0.0	0.0	0.0	1.0	1.0	1.0	0.0
Near and Middle East	7	0.4	0.1	0.3	0.0	0.1	0.3	0.1	0.1
World	128	0.8	0.5	0.4	0.4	0.6	0.7	0.6	0.5

Note: Countries provided a score (none, limited or extensive) for the level of collaboration in each category of activity. The scores were converted into numerical values (none = 0; limited = 1; extensive = 2). The figures shown in the table are average scores for the respective categories.

Most countries did not report specific institutions or stakeholder bodies that coordinate activities in the various subsectors of genetic resources. Some country reports note that the fact that different types of genetic resources are addressed by different ministries is a constraint to collaboration and coordination. Nonetheless, a number of coordinating structures or bodies, of various types are mentioned in the country reports, including ministerial or interministerial committees (e.g. Finland, Gabon), foundations (e.g. France), genetic resources centres (e.g. Brazil, Norway, Sweden) and genetic resources networks (e.g. the Plurinational State of Bolivia). In other countries, particular stakeholders play an integrating role with regard to specific aspects of genetic resources management (e.g. gene banking or research).

In addition to the above-mentioned concern about lack of coordination between government ministries, the main constraints to integrated approaches to genetic resources management noted in the country reports are a lack of funds, insufficient training of staff working for relevant institutions, lack of sensitization and education among stakeholders and the general public, a lack of national level strategies and legislations, and a lack of coordination between administrative and field levels. Some country reports suggest that relatively small-scale initiatives such as integrated projects and workshops could be a means of fostering collaboration on a larger scale.

The main potential benefits of an integrated approach foreseen in the country reports are: in administrative terms, savings in time and costs; and, at field level, more efficient and sustainable use of natural resources and the reduction of conflicts related to resource use.

DRAFT – NOT FOR CITATION

3. Institutional frameworks at subregional and regional levels

3.1. Regional focal points and networks for the management of animal genetic resources

Collaboration between countries at regional level can facilitate action in many areas of AnGR management. The Global Plan of Action calls for the establishment of regional focal points for the management of AnGR and for the strengthening of international networks (see Box 3A1). Detailed advice on the establishment and operation of regional focal points was provided in FAO's guidelines on *The development of institutional frameworks for the management of animal genetic resources* (FAO, 2011a). As of mid-2014, the following focal points and networks were in operation:

- Asian Animal Genetic Resources Network;
- European Regional Focal Point for Animal Genetic Resources;
- Regional Focal Point for Latin America and the Caribbean;
- Sub-Regional Focal Point for West and Central Africa; and
- Animal Genetic Resources Network Southwest Pacific.

As part of the reporting process for the second SoW-AnGR, regional focal points and networks were invited to report on regional-level activities contributing to the implementation of the Global Plan of Action. Reports were received from Asia, Europe, Latin America and the Caribbean and the Southwest Pacific. The reports can be accessed at [crossref]. Regional focal points and networks also participated in the previous round of reporting on the implementation of the Global Plan of Action (FAO, 2012).[1]

The European Regional Focal Point is the longest-established and most active regional focal point. During the period since the adoption of the Global Plan of Action, it has been active in the implementation of all four of the Plan's strategic priority areas. In the field of characterization inventory and monitoring (Strategic Priority Area 1), actions have included work on the establishment of a regional information system for AnGR (the European Farm Animal Biodiversity Information System – EFABIS) and steps to harmonize risk-status and endangerment criteria. In the field of sustainable use and development (Strategic Priority Area 2), actions have included contributing to discussions related to the European Union's legal framework on access and benefit-sharing. In the field of conservation (Strategic Priority Area 3), actions have included the organization of training activities, the provision of support to a number of conservation projects and, in 2014, the establishment of the European Gene Bank Network for Animal Genetic Resources (EUGENA) (see also Box [crossref]. In the field of policies, institutions and capacity building (Strategic Priority Area 4), actions have included contributing to discussions on the development of the European Union's legal and policy frameworks in areas relevant to AnGR management.

The Regional Focal Point for Latin American and the Caribbean, was established in 2007. Its main activity has been the organization of a number of regional workshops for National Coordinators. Priorities for the future are reported to include seeking financial support for the organization of training courses and for collaborative activities at regional and/or bilateral levels. In the Southwest Pacific, an online network for discussion, dissemination of information and communication between National Coordinators has been established. Other activities have included characterization and conservation projects for locally adapted pigs and chickens involving a number of countries. In 2012, the recently established Sub-Regional Focal Point for West and Central Africa reported a number of priorities for future action. However, it did not participate in the 2014 round of reporting. The Asian Animal Genetic Resources Network, established in late 2013, has agreed an organizational structure and intends to focus on information exchange, providing assistance and technical advice, and mobilizing funds.

[1] Reports were received from Europe, Latin America and the Caucasus, the Southwest Pacific, and West and Central Africa. The Asian regional focal point was not in operation at the time. All regional progress reports are available on FAO's web site: http://www.fao.org/ag/againfo/programmes/en/genetics/Reporting_system_2007-11.html#secondo

DRAFT – NOT FOR CITATION

3.2. Other collaborative activities at regional and subregional levels

The focal points and networks discussed above exist specifically to strengthen the implementation of the Global Plan of Action at regional level. However, a range of other players also contribute to this goal. The roles of regional political and economic unions and communities (e.g. the European Union and the subregional economic communities of Africa) in the establishment of regional-level legal and policy instruments relevant to AnGR management are discussed in Section [crossref]. Regional and subregional-level AnGR management activities can also be organized or supported by NGOs, intergovernmental organizations (e.g. UN agencies) or research organizations (e.g. CGIAR centres). Countries can also enter directly into collaborative activities with their regional neighbours.

While the analysis presented in the *Synthesis progress report on the implementation of the Global Plan of Action* (FAO, 2014) indicates that international collaboration is one of the elements of the Global Plan of Action in which least progress has been made, a number of countries report that they have participated in collaborative activities at regional level. For example, in response to a specific question about regional *in situ* conservation projects, more than 40 percent of countries indicate that they have contributed to the development and implementation of such programmes. A somewhat lower number (approximately 30 percent) report that they have contributed to "international cooperative inventory, characterization and monitoring activities involving countries sharing transboundary breeds and similar production systems", many of which are likely to have been at regional level. Collaboration in these fields is more advanced in developed regions than elsewhere in the world.

The level of international cooperation within Europe is greatly increased by the above-described work of the European Regional Focal Point. However, a number of examples of bilateral collaboration or collaboration involving small groups of countries are also reported. In the Americas, Brazil, Canada and the United States of America have cooperated in the development of an information system for the management of data related to conservation activities. The main other initiative reported from Latin America and the Caribbean is the REGENSUR Platform created by Southern Cone Cooperative Program for Technological Development in Agri-Food and Agroindustry (PROCISUR) of the Inter-American Institute for Cooperation on Agriculture of the Organization of American States, which in 2010 expanded its mandate to include animals and micro-organisms in addition to plants. Collaborative work is envisaged in the fields of sustainable use, conservation, policies and capacity-building, with the aim that these efforts will reinforce the implementation of national strategies and action plans for AnGR in the countries of the Southern Cone of South America. Regional-level initiatives in Africa have mostly occurred under the auspices of AU-IBAR.

AnGR-focused NGOs working at regional or subregional levels are reported mainly from Europe. Examples include Safeguard for Agricultural Varieties in Europe (SAVE Foundation) (see Boxes 3A4 [crossref]) and the Danubian Countries Alliance of Genes in Animal Species (DAGENE). Research organizations active at regional level include the Arab Center for the Studies of Arid Zones and Dry Lands (mandate covering all Arab states), whose activities include inventory and characterization studies, breeding programmes, AnGR-related training activities and awareness-raising in the fields of conservation and sustainable use.

Box 3A4. Facilitating the establishment of institutional frameworks for animal genetic resources management – lessons from a project in Bulgaria

Safeguard for Agricultural Varieties in Europe (SAVE) Foundation was invited to assist with addressing the institutional framework for AnGR management within the programme: Linking Nature Protection and Sustainable Rural Development[1], a Swiss Agency for Cooperation funded project in Bulgaria. In 2014, SAVE undertook two missions to Bulgaria. The first to meet stakeholders and gain

DRAFT – NOT FOR CITATION

an overview of the state of the conservation measures for indigenous breeds at risk, both at policy level and on the ground, and the second to facilitate stakeholder meetings. Stakeholder meetings addressed both technical matters related to the genotyping of livestock populations and matters related to the development of effective institutions and policies. Among the latter, the following topics received particular attention:

- the need to improve communication among stakeholders;
- the need to unify scattered AnGR-related policy and regulatory provisions, so that the overall strategy is clear and any contradictions can be addressed;
- the need for thematic workshops to ensure that all stakeholders have the same level of knowledge; and
- the need to revise subsidy programmes on the basis of recommendations from the European Regional Focal Point for AnGR and the results of genotyping studies.

Stakeholders from all levels, government to farmers, attended these meetings, actively participating in discussions. SAVE's role in this context was to make recommendations based on discussions with implementation taking place at national level. From this example and previous involvement of SAVE in similar capacities, it is apparent that discussing frameworks between all stakeholders creates a transparent approach, allowing everyone to be involved in planning future activities and adds sustainability to the process.

[1] *http://www.swiss-contribution.admin.ch/bulgaria/en/Home/Projects/Project_Detail?projectinfoID=214077*
Provided by Elli Broxham, SAVE Foundation.

4. Institutional frameworks and stakeholders at international level

A range of different entities contribute to the institutional framework for the management of AnGR at international level (i.e. global or spanning more than one region). As at regional level, these include intergovernmental organizations, NGOs and research organizations. International policy and legal frameworks developed by global intergovernmental bodies such as the Convention on Biological Diversity (CBD), FAO and the World Intellectual Property Organization (WIPO) are discussed in Section [crossref].

The international instrument most directly focused on AnGR management is, clearly, the Global Plan of Action, which was negotiated under the auspices of FAO's Commission on Genetic Resources for Food and Agriculture. The Commission is also responsible for overseeing and monitoring the implementation of the Global Plan of Action and FAO plays the leading role globally in terms of supporting the Plan's implementation and administering the monitoring process. FAO's activities are described in Boxes 3A5 and 3A6. The Commission provides an intergovernmental forum for ongoing discussion of issues relevant to the management of AnGR and other biodiversity for food and agriculture.

Box 3A5. FAO's role in the management of animal genetic resources

FAO's role focuses on assisting countries in the implementation of the Global Plan of Action, particularly by:

- raising awareness and promoting animal genetic resources issues;
- collaborating with international bodies and organizations addressing sectoral and cross-sectoral issues of relevance to AnGR management;
- developing and maintaining a global information and communication structure for AnGR (namely DAD-IS and DAD-net);
- supporting the establishment of National and Regional Focal Points;
- coordinating activity among regions;
- monitoring the implementation of the Global Plan of Action;
- overseeing preparation of a range of policy and technical guidelines;
- assisting countries in building national capacity in animal genetic resources management;

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- developing programme and project proposals; and
- mobilizing donor resources.

For further information see: http://www.fao.org/Ag/AGAInfo/programmes/en/A5.html

Box 3A6. The Domestic Animal Diversity Network (DAD-net)

Established in 2005 by the FAO's Animal Production and Health Division, DAD-net is a moderated global electronic discussion forum where information and experiences on issues relevant to the management of AnGR can be informally discussed. Membership is open to anybody interested in the management of AnGR, particularly National Coordinators and their networks, decision-makers, academics and NGOs. Information is exchanged on training and education opportunities, research and technological developments, technology transfer and other subjects relevant to AnGR management. As of October 2014, the network had 2 500 members, from 185 countries. Regional subgroups have been established for Asia and the Pacific, Latin America and Caribbean, East Africa, North Africa, West and Central Africa, and Eastern Europe and Central Asia.

For further information see:
https://dgroups.org/fao/dad-net; http://www.fao.org/Ag/AGAInfo/programmes/en/genetics/discussion_group.html

The ongoing work of both WIPO and the Secretariat of the Convention on Biological Diversity also supports the implementation of the Global Plan of Action in various ways. Both bodies submitted reports on their activities as part of the second SoW-AnGR reporting process. WIPO's report notes, in particular, its *Patent landscape report on animal genetic resources* ([crossref]) and ongoing negotiations taking place in the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore. The report from the CBD Secretariat notes, *inter alia*, work taking place under the Global Taxonomy Initiative, efforts to promote the ecosystem approach, work related to the Nagoya Protocol on Access and Benefit Sharing, work related to the Convention's Article 8(j) – Traditional Knowledge, Innovations and Practices, and the periodic publication of the *Global Biodiversity Outlook.* As discussed in Section [crossref], the Secretariats of the CBD and the Commission have agreed a joint work plan with the aim of promoting synergies in efforts to implement the CBD's Strategic Plan for Biodiversity 2011–2020 and the Commission's Multi-Year Progamme of Work. Another UN body that contributes to the implementation of the Global Plan of Action in a specific field is the International Atomic Energy Agency (IAEA), assisting countries through the transfer of nuclear-related technologies, including biotechnologies, and complementary tools. Among the technologies relevant to AnGR management are molecular genetic testing, hormone monitoring and artificial insemination.

The main international research organizations with mandates relevant to the management of AnGR are Bioversity International, the International Center for Agricultural Research in the Dry Areas (ICARDA) and the International Livestock Research Institute (ILRI). The latter two organizations undertake a range of activities in a range of areas relevant to the implementation of the Global Plan of Action, including characterization studies, work on the establishment of community-based breeding programmes and provision of support to policy development. Bioversity's AnGR-related work focuses mainly on economic valuation (see Section [crossref]). All three organizations submitted reports on their activities as part of the second SoW-AnGR reporting process.

The number of international NGOs actively supporting the implementation of the Global Plan of Action is limited. Only a few organizations in this category submitted reports as part of the second Sow-AnGR reporting process: Heifer International; the International Committee for Animal Recording; the League for Pastoral Peoples and Rare Breeds International. The missions of these organizations are shown in Table 3A1.

DRAFT – NOT FOR CITATION

Table 3A1. Organizations supporting animal genetic resources management at regional and international level

Organization name and web link	Type	Description of mission
African Union Interafrican Bureau for Animal Resources (AU-IBAR) http://www.au-ibar.org/	IGO	To provide leadership in the development of animal resources for Africa through supporting and empowering African Union Member States and Regional Economic Communities.
Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) http://www.acsad.org/	IGO	To develop plant varieties and animal breeds resistance to drought and integrated management of water resources, preserve the environment and biodiversity and combat desertification.
Bioversity International http://www.bioversityinternational.org/	CGIAR	To deliver scientific evidence, management practices and policy options to use and safeguard agricultural biodiversity to attain sustainable global food and nutrition security.
The Secretariat of the Convention of Biological Diversity (CBD) www.cbd.int/secretariat/	UN	Supporting the goals of the Convention: - the conservation of biological diversity - the sustainable use of its components - the fair and equitable sharing of benefits arising from the use of genetic resources.
Danubian Countries Alliance of Genes in Animal Species (DAGENE) http://www.dagene.eu/	NGO	Genetic preservation in the Danube river basin
European Federation of Animal Science (EAAP) www.eaap.org/	NGO	To promote the improvement, organization and enlightened practice of animal production by scientific research, the application of science and cooperation between the national animal production organizations, scientists and practitioners of member countries.
Heifer International www.heifer.org/	NGO	To eradicate poverty and hunger through sustainable, values-based holistic community development through distributing animals, along with agricultural and values-based training, to families in need around the world as a means of providing self-sufficiency.
International Atomic Energy Agency (IAEA) – Joint FAO/IAEA Division www.iaea.org/	UN	To support Member States in the peaceful application of nuclear science and technology in a safe and effective manner to provide their communities with more, better and safer food and agricultural produce while sustaining natural resources.
International Centre for Agricultural Research in the Dry Areas (ICARDA) www.icarda.cgiar.org/	CGIAR	To improve the livelihoods of the resource-poor across the world's dry areas.
International Committee for Animal Recording (ICAR) www.icar.org/	NGO	To promote the development and improvement of the activities of performance recording and the evaluation of livestock.
International Livestock Research Institute (ILRI) http://www.ilri.org/	CGIAR	To improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock.
League for Pastoral Peoples and Endogenous Livestock Development (LPP) http://www.pastoralpeoples.org/	NGO	To support pastoral societies and other small-scale livestock keepers to pursue their own vision of development through research, technical support, advisory services and advocacy, including endogenous development built on local knowledge, institutions and resources.
NORDGEN - Nordic Genetic Resource Center Farm Animals http://www.nordgen.org/	IGO	To safeguard the sustainable use of plants, farm animals and forests, securing the broad diversity of genetic resources linked to food and agriculture through conservation and sustainable use, solid documentation and information work and international agreements.
Rare Breeds International http://www.rarebreedsinternational.org/	NGO	To prevent the loss of diversity in global farm animal genetic resources.
Safeguard for Agricultural Varieties in Europe (SAVE Foundation) http://www.save-foundation.net/	NGO	A European umbrella organization for the promotion and coordination of activities for the *in situ* conservation of at risk breeds of domestic animals and cultivated plant varieties.
World Intellectual Property Organization www.wipo.int/	UN	To lead the development of a balanced and effective international intellectual property system that enables innovation and creativity for the benefit of all.

Note: IG = Intergovernmental organization.

DRAFT – NOT FOR CITATION

A number of NGOS and civil society organizations have also taken on a campaigning role at international level. The emergence of the concept of "Livestock Keepers' Rights", for example, was discussed in the first SoW-AnGR[2] (recent developments are described in Box 3A7). Another issue that has become increasingly prominent in the work of civil society organizations in recent years is the development of so-called biocultural community protocols in livestock-keeping communities (see Part 4 Section [crossref]).

Box 3A7. Livestock Keepers' Rights

"Livestock Keepers' Rights" is a concept developed by civil society (including non-governmental organizations and herders' associations) during the "Interlaken Process". It is based on the rationale that many breeds in developing countries disintegrate because of the loss of the customary rights of livestock keepers to sustain their livestock on common property resources, as well as policies that are adverse to small-scale livestock keepers. Livestock Keepers' Rights are a set of principles that would support and encourage livestock keepers to continue making a living from their breeds and thereby achieve the combined effect of conserving diversity and improving rural livelihood opportunities.

The term Livestock Keepers' Rights was first coined during the 2002 World Food Summit, in allusion to the Farmers' Rights enshrined in the International Treaty on Plant Genetic Resources for Food and Agriculture. In a series of consultations and workshops held with hundreds of livestock keepers from more than 20 countries in Karen (Kenya) in 2003, Bellagio (Italy) in (2006), Yabello (Ethiopia) in 2006, Sadri (India) and Addis Ababa (Ethiopia) in 2007, Livestock Keepers' Rights were elaborated into a much more comprehensive concept than Farmers' Rights. Rather than representing legal rights, they correspond to development principles that would help livestock keepers continue to conserve biodiversity.

Principles and rights

During a workshop with legal experts held in Kalk Bay, South Africa in December 2008, the rights were further refined and subdivided into principles and rights:

"Principle 1: Livestock Keepers are creators of breeds and custodians of animal genetic resources for food and agriculture....

Principle 2: Livestock Keepers and the sustainable use of traditional breeds are dependent on the conservation of their respective ecosystems....

Principle 3: Traditional breeds represent collective property, products of indigenous knowledge and cultural expression of Livestock Keepers....

Based on these principles articulated and implicit in existing legal instruments and international agreements, Livestock Keepers from traditional livestock keeping communities and/or adhering to ecological principles of animal production, shall be given the following Livestock Keepers' Rights:

1. Livestock Keepers have the right to make breeding decisions and breed the breeds they maintain.
2. Livestock Keepers shall have the right to participate in policy formulation and implementation processes on animal genetic resources for food and agriculture.
3. Livestock Keepers shall have the right to appropriate training and capacity building and equal access to relevant services enabling and supporting them to raise livestock and to better process and market their products.
4. Livestock Keepers shall have the right to participate in the identification of research needs and research design with respect to their genetic resources, as is mandated by the principle of Prior Informed Consent.
5. Livestock Keepers shall have the right to effectively access information on issues related to their local breeds and livestock diversity."

The Declaration on Livestock Keepers' Rights that emanated from the Kalk Bay Workshop references these principles and rights to existing international agreements and legal frameworks such as the Convention on Biological Diversity, the United Nations Convention to Combat Desertification, the Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration on Animal Genetic Resources, the Universal Declaration of Human Rights, the International Covenant on Economic, Social and Cultural Rights, the United Nations Declaration on the Rights of Indigenous

[2] First SoW-AnGR, page 291.

Peoples, the Convention on the Protection and Promotion of the Diversity of Cultural Expressions, the Convention (No. 169) concerning Indigenous and Tribal Peoples in Independent Countries, the Declaration on the Rights of Persons belonging to National or Ethnic, Religious and Linguistic Minorities and other pertinent instruments.

The Declaration was signed by a large number of individuals and organizations. Subsequently, the participants of the International Technical Expert Workshop on Access and Benefit Sharing in Animal Genetic Resources for Food and Agriculture, held in Wageningen, the Netherlands, in December 2010, recommended that "Livestock Keepers' Rights should be addressed."

Livestock Keepers' Rights are frequently referred to as a potential tool for protecting the rights of livestock keepers in a context where scientists and industries are making increasing use of the intellectual property rights system to protect their advances in breeding and associated technologies. However, their scope is not restricted to the right to breed, save and exchange genetic material. It encompasses a broader approach that would strengthen small-scale livestock keepers and support them in making a living in their traditional agro-ecosystems.

The discussion about Livestock Keepers' Rights may be revived once The Nagoya Protocol on Access and Benefit-Sharing is ratified, as the Protocol requires its Contracting Parties to share monetary and non-monetary benefits arising from the utilization of traditional knowledge associated with genetic resources and from the utilization of genetic resources held by indigenous and local communities with these communities. As described above, non-monetary benefits, such as the participation of livestock keepers in policy formulation and implementation processes on animal genetic resources, training and capacity-building, access to services, marketing support, identification of research needs and access to information, are among the demands made in the Declaration on Livestock Keepers' Rights.

Provided by Ilse Köhler-Rollefson.
For further information see: Köhler-Rollefson and Wanyama 2003; Köhler-Rollefson et al., 2010a, Köhler-Rollefson et al., 2010b, Köhler-Rollefson et al. 2012; FAO 2011c.

5. Changes since 2005

Table 3A2 compares the scores for the state of capacity and provision presented above in Subsection 2 to the equivalent figures from the first SoW-AnGR process,[3] taking into account only the 109 countries that participated in both reporting processes. It is important to note that the figures are not directly comparable. Aside from the inevitable element of subjectivity involved in such scoring exercises, the scores used in the first report were allocated on the basis of the textual descriptions presented in the country reports rather than being directly assigned by the countries themselves.[4] While the figures therefore have to be interpreted with some caution, the global trends over the 2005 to 2014 period have been positive (scores increased) or neutral (scores stayed the same) in all aspects of the institutional framework considered. The figures indicate declines in some areas of capacity in some regions, most commonly in Latin America and the Caribbean. These declines are clearly of some concern, but are perhaps accounted for by overly generous allocation of scores during the first SoW-AnGR process.

At international level, the major change since 2005 has been the adoption of the Global Plan of Action. Implementation of most of the Plan's strategic priorities take place mainly at national level (see also Part 3 Section Legal and policy frameworks, Table [crossref]). The state of implementation of these strategic priorities is described in detail in FAO (2014). As described above, activities related to the development of the institutional frameworks fall mainly within Strategic Priority Area 4 of the Global Plan of Action (see Box 3A1). The *Synthesis progress report on the implementation of the Global Plan of Action* (FAO, 2014) includes an analysis of the progress made (as reported in the country reports) in the implementation of the various elements of the Global Plan of Action since its adoption in 2007. Many examples of improvements to institutional frameworks are reported. However, relative to the amount of work that remains to be done in order to establish effective

[3] Figures 44 to 46 and Table 58 of the first SoW-AnGR (pages 205–213).
[4] Countries had the opportunity to request amendments during the reviewing process.

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institutional frameworks in all countries, progress has been modest. On the positive side, the number of countries having a National Coordinator in place is higher in 2014 than ever before. The number of countries that have developed or are in the process of developing national strategies and action plans for AnGR (see Section [crossref]) is also encouraging. National plans targeting AnGR management in a holistic sense were rare prior to the adoption of the Global Plan of Action. Thirty-percent of country reports note an increase in national funding for AnGR management since 2007.

Table 3A2. Assessment of institutions and stakeholders at regional level – state and changes 2005 to 2014

	Africa n = 35			Asia n = 18			Europe & the Caucasus n = 29			Latin America & the Caribbean n = 16			Near & Middle East n = 5			Southwest Pacific n = 5			World n = 109		
	2005	2014	Δ	2005	2014	Δ	2005	2014	Δ	2005	2014	Δ	2005	2014	Δ	2005	2014	Δ	2005	2014	Δ
Research	0.8	1.5	0.7	1.4	1.6	0.2	2.1	2.3	0.2	1.6	1.8	0.2	1.2	1.8	0.6	0.8	0.4	-0.4	1.4	1.7	0.3
Knowledge	0.7	1.4	0.7	1.3	1.8	0.5	2.2	2.3	0.1	1.6	1.7	0.1	1	1.8	0.8	0.6	1.4	0.8	1.4	1.8	0.4
Awareness	0.9	1.1	0.2	1.5	1.7	0.2	2.2	2	-0.2	1.6	1.2	-0.4	1	1	0	0.4	1.2	0.8	1.5	1.5	0
Infrastructure	1	1.1	0.1	1.4	1.5	0.1	2.1	2.2	0.1	1.8	1.4	-0.4	1.2	1	-0.2	0.8	0.6	-0.2	1.5	1.5	0
Stakeholder participation	0.6	1.1	0.5	1	1.5	0.5	2	2.2	0.2	1.4	1.5	0.1	0.4	0.8	0.4	0.4	1.2	0.8	1.2	1.5	0.3
Laws & policies	0.5	1.2	0.7	1.2	1.8	0.6	2	2.4	0.4	1.4	1.1	-0.3	0.8	1.2	0.4	0.6	0.8	0.2	1.2	1.6	0.4
Implementation of laws & policies	0.3	1	0.7	0.9	1.5	0.6	1.8	2.3	0.5	1	0.9	-0.1	0.6	0.9	0.3	0.2	0.8	0.6	0.9	1.4	0.5

Notes: This comparison is based on the country reports of 109 countries that reported to both the first and second SoW-AnGRs. The date 2005 refers to the year in which the last country reports were submitted during the first reporting process (some reports were submitted as early as 2002). Scores: 0=none; 1=low; 2=medium; 3=high. In 2005, laws and policies were treated as a single category, while in 2014 they were scored separately. The 2014 scores for "laws and policies" and "implementation of laws and policies" shown in the table are averages of the scores for policies and the scores for laws.

Given that at the time the first SoW-AnGR was prepared only one regional focal point (Europe) was in operation, the existence of four additional focal points and networks represents a significant step forward. However, there is clearly scope for further improvement, both in terms of the coverage of regional and subregional focal points and in terms of the level of activity of existing focal points.

The number of international organizations involved in promoting the sustainable use development and conservation of AnGR has not increased since 2005. However, four international organizations (AU-IBAR, IAEA, ILRI and SAVE Foundation) report that their budgets for activities supporting AnGR-related activities have increased since the adoption of the Global Plan of Action.

6. Conclusions and priorities

In general, the conclusions drawn in the first SoW-AnGR remain valid. Without effective institutions, it is difficult to make progress in terms of strengthening AnGR management programmes. Major gaps and weakness in institutional frameworks still need to be addressed. The most positive development in recent years has probably been the more widespread establishment of specifically AnGR-focused structures and instruments, in particular National Focal Points (appointment of National Coordinators) and national strategies and action plans. These developments indicate that AnGR management has acquired at least a foothold on national political agendas. This is further illustrated by the large number of country reports submitted despite the short period of time available in which to prepare them. The development and strengthening of Regional Focal Points and networks is another indicator of countries' interest in AnGR management.

While legal and policy frameworks are still reported to be far from adequate in many countries, they have been supplemented by a substantial number of new instruments over recent years (see Section [crossref] for further discussion). However, effective implementation remains a problem for many countries. In many cases, the basic prerequisites for effective policy implementation – physical and organizational infrastructure, stakeholder participation, and knowledge and awareness of AnGR-related issues – remain weak or absent. The consequences of these weaknesses are evident in many of the areas of AnGR management discussed in the country reports. Aside from the ubiquitous lack of sufficient funding, lack of knowledge and technical skills, lack of stakeholder participation and inadequate or poorly implemented policies are among the main reported constraints to the

DRAFT – NOT FOR CITATION

establishment of effective AnGR management programmes in all fields from surveying and monitoring to conservation and genetic improvement.

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DRAFT – NOT FOR CITATION

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SECTION AB. CHARACTERIZATION, INVENTORY AND MONITORING

1. Introduction

Characterization, inventory and monitoring of animal genetic resources (AnGR) are essential to their sustainable management. Information on breeds' characteristics facilitates effective planning of how and where they can best be used and developed. Assessing risk status (the likelihood that breeds will become extinct if no remedial action is taken) is a key element of AnGR management at national level. This requires information on the size and structure of breed populations and how these change over time. A range of different approaches and specific tools are available for use in gathering information on the characteristics of individual animals and livestock populations (FAO, 2011a, 2011b, 2012). The state of the art in this field is described in Part 4 Section [crossref]) and Part 4 Section [crossref], the latter focusing specifically on molecular genetic tools.

This section provides an overview of the state of implementation of characterization, inventory and monitoring activities, based on the information provided in the country reports. The country report questionnaire included two subsections focused on characterization activities. The first of these requested countries to provide information on the extent to which their national breed populations have been subject to various types of characterization study (see Box 3AB1). Countries were obliged to provide this information for the "big five" livestock species (cattle, sheep, goats, pigs and chickens). Providing information on other species was optional. The other subsection addressed countries' progress in implementing Strategic Priority Area 1 of the Global Plan of Action for Animal Genetic Resources (Characterization, Inventory and Monitoring of Trends and Associated Risks). Countries were required to report on the state of development of institutional and organizational arrangements for activities in this field, as well as on the state of implementation of various activities. The questionnaire also provided countries with an opportunity to describe obstacles and constraints to the implementation of activities in this strategic priority area. Detailed analysis is provided in the *Synthesis progress report on the implementation of the Global Plan of Action for Animal Genetic Resources – 2014* (FAO, 2014a).

Box 3AB1. Characterization – definitions of terms

Baseline survey of population size: A survey that obtains sufficient population data to determine a breed's risk status at national level. It provides a reference point for monitoring population trends.

Regular monitoring of population size: A systematic set of activities undertaken to document changes in the population size and structure over time.

Phenotypic characterization: The process of identifying distinct breed populations and describing their morphological and production characteristics within given production environments; it includes the description of the breed's production environments and recording of their geographical distributions.

Genetic diversity studies based on pedigree: Studies that involve estimating genetic relationships among animals based on the probabilities of their sharing alleles from common ancestors. At breed level, average coefficients of inbreeding and/or kinships and their trends over time are the most commonly used measures.

Molecular genetic diversity studies within breed: Studies that involve the genotyping of individual animals within a breed for a set of molecular markers, for the purpose of evaluating diversity within the breed and the genetic relationships between animals. At breed level, heterozygosity is the most

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important parameter used. Higher heterozygosity indicates higher diversity. Relationships between animals are measured based on the proportion of alleles in common across the markers genotyped.

Molecular genetic diversity studies between breeds: Studies that involve the genotyping of representative groups of animals from a group of breeds for the purpose of evaluating genetic similarity between the breeds. Genetic distance, a measure of the similarity of the allele frequencies between breeds, is a commonly used parameter to measure relationships between breeds.

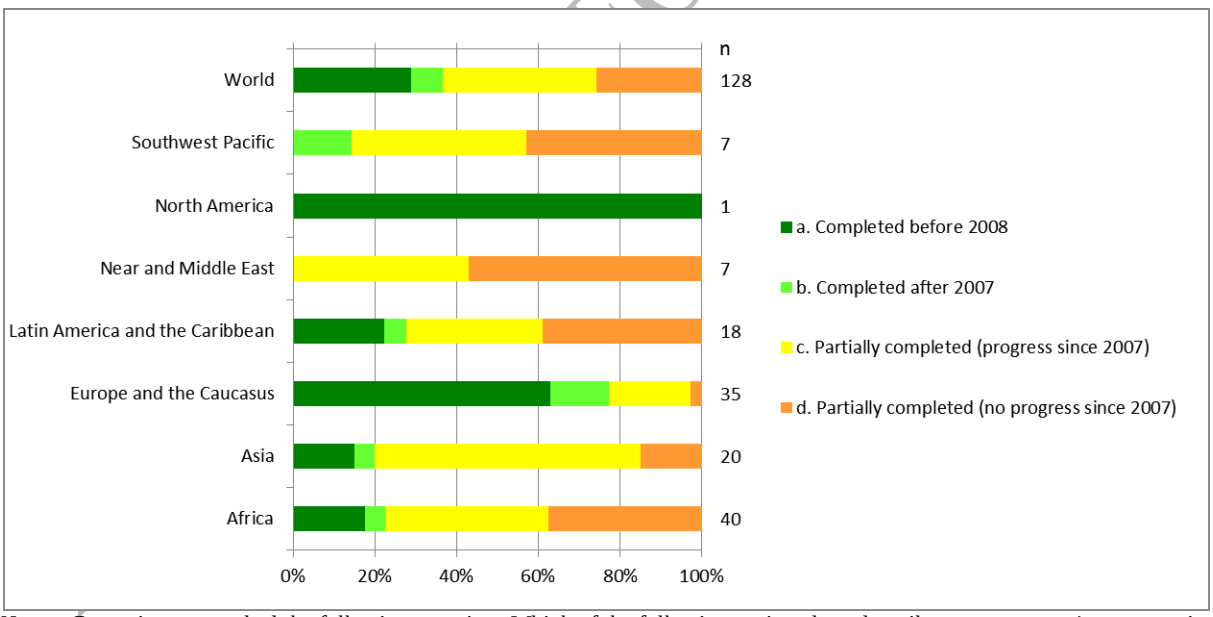
Genetic variance components estimation: Use of pedigree and performance data to estimate which part of the phenotypic variance in a population can be explained by different genetic effects.

Molecular genetic evaluation: The inclusion of molecular genetic information in the procedure for genetic evaluation. This includes consideration of genotypes for a few specific genes and prediction of "genomic breeding values" by using information from large panels of single nucleotide polymorphisms.

2. Development of national breed inventories

A national breed inventory is a comprehensive list of the breeds present in a given country. Given that the breed is the unit of management for many AnGR-related activities, including conservation programmes, establishing a complete inventory is an important objective. Figure 3AB1 presents a region by region summary of the reported state of countries' national breed inventories, indicating whether or not further progress has been made since the adoption of the Global Plan of Action. The results show that while progress has been made in a large number of countries in recent years, the majority of countries (63 percent) consider that their inventories are not yet complete.

Figure 3AB1. Progress in the establishment of national breed inventories



Notes: Countries were asked the following question: Which of the following options best describes your country's progress in building an inventory of its animal genetic resources covering all livestock species of economic importance? Response options were as follows: a. Completed before the adoption of the GPA; b. Completed after the adoption of the GPA; c. Partially completed (further progress since the adoption of the GPA);d. Partially completed (no further progress since the adoption of the GPA). The following definition was provided: "An inventory is a complete list of all the different breeds present in a country."
Source: FAO 2014a.

3. Baseline surveys and monitoring of population sizes

This subsection focuses on activities undertaken in order to obtain data on the size and structure of national breed populations. The term "baseline survey" is used to refer to an initial data gathering exercise that provides sufficient data to allow a breed population's risk status to be assessed accurately; ongoing activities that provide the data needed to track a breed's risk status over time are referred to as "monitoring" (FAO, 2011). The state of implementation of surveying and monitoring activities for the "big five" species, grouped by region and subregion, is presented in Table 3AB1.

Table 3AB1. Reported proportions of national breed populations ("big five" species) for which baseline surveys have been conducted and for which regular monitoring is implemented

Regions and subregions	Number of countries	Number of national breed populations	Baseline survey of population size (%)	Regular monitoring of population size (%)
Africa	**40**	**1317**	**46**	**23**
East Africa	8	289	63	24
North and West Africa	20	563	30	13
Southern Africa	12	465	56	35
Asia	**20**	**1323**	**40**	**20**
Central Asia	4	165	81	42
East Asia	4	548	33	17
South Asia	6	276	49	15
Southeast Asia	6	334	27	26
Southwest Pacific	**7**	**216**	**27**	**26**
Europe and the Caucasus	**35**	**4090**	**78**	**75**
Latin America and the Caribbean	**18**	**1164**	**35**	**78**
Caribbean	5	142	**18**	**30**
Central America	5	324	**5**	**40**
South America	8	698	**5**	**32**
North America	**1**	**241**	**92**	**92**
Near & Middle East	**7**	**168**	**29**	**20**
World	**128**	**8519**	**71**	**57**

Note: The number of national breed populations refers to the number reported in the country reports. "Big five" species = cattle, sheep, goats, pigs and chickens.

The country-report data indicate that baseline surveys have been conducted for 53 percent of reported national breed populations belonging to the big five species. Only 44 percent of national breed populations are monitored regularly. It is important to note that the world figures are greatly influenced by figures from Europe and the Caucasus, which accounts for a large proportion (48 percent) of the total number of reported national breed populations in these species. In this region, the majority (64 percent) of national breed populations (all figures refer to the big five species) are monitored regularly. Nonetheless, a substantial proportion of national breed populations (32 percent) have not been subject to a baseline survey. The coverage of both baseline surveys and monitoring programmes is high (92 percent coverage) in North America (represented in the country reporting only by the United States of America). Elsewhere in the world, a few subregions – East Africa, Southern Africa and Central Asia – have a relatively high proportion (more than 50 percent) of national breed populations that have been subject to baseline surveys, but coverage is generally low. The coverage of monitoring programmes is relatively high (more than 30 percent) in some developing subregions – Southern Africa, Central Asia, Southeast Asia, the Caribbean and Central America – but low or very low elsewhere.

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Table 3AB2. Reported proportions of national cattle breed populations for which baseline surveys have been conducted and for which regular monitoring is implemented

Regions and subregions	Dairy cattle			Beef cattle			Multipurpose cattle		
	Number of national breed populations	Baseline survey (%)	Monitoring (%)	Number of national breed populations	Baseline survey (%)	Monitoring (%)	Number of national breed populations	Baseline survey (%)	Monitoring (%)
Africa	**149**	**42**	**23**	**208**	**45**	**36**	**176**	**60**	**23**
East Africa	34	41	21	19	53	21	73	63	16
North and West Africa	67	28	18	79	23	11	66	45	18
Southern Africa	48	63	33	110	59	56	37	78	43
Asia	**68**	**54**	**37**	**119**	**40**	**29**	**142**	**36**	**8**
Central Asia	16	94	69	17	94	47	10	60	40
East Asia	10	90	70	27	48	30	60	7	0
South Asia	21	43	10	2	50	50	55	69	11
Southeast Asia	21	19	24	73	25	23	17	18	6
Southwest Pacific	**13**	**19**	**24**	**33**	**25**	**23**	**11**	**18**	**6**
Europe and the Caucasus	**206**	**86**	**80**	**425**	**84**	**85**	**219**	**82**	**80**
Latin America and the Caribbean	**103**	**86**	**80**	**247**	**40**	**85**	**65**	**31**	**80**
Caribbean	17	35	31	15	27	34	14	36	23
Central America	37	35	18	74	46	27	26	31	36
South America	49	30	30	158	39	46	25	28	31
North America	**15**	**73**	**73**	**59**	**93**	**93**	**4**	**100**	**100**
Near & Middle East	**19**	**47**	**26**	**7**	**14**	**14**	**19**	**37**	**32**
World	**573**	**78**	**64**	**1098**	**72**	**67**	**636**	**78**	**54**

Table 3AB3. Reported proportions of national sheep, goat, pig and chicken breed populations for which baseline surveys have been conducted and for which regular monitoring is implemented

Regions and subregions	Sheep			Goat			Pig			Chicken		
	Number of national breed populations	Baseline survey (%)	Monitoring (%)	Number of national breed populations	Baseline survey (%)	Monitoring (%)	Number of national breed populations	Baseline survey (%)	Monitoring (%)	Number of national breed populations	Baseline survey (%)	Monitoring (%)
Africa	**178**	**54**	**28**	**170**	**51**	**25**	**143**	**36**	**16**	**293**	**31**	**11**
East Africa	44	64	32	45	69	29	20	90	40	54	61	11
North and West Africa	73	41	15	65	37	17	69	25	7	144	13	5
Southern Africa	61	64	39	60	53	30	54	31	19	95	43	21
Asia	**224**	**58**	**15**	**189**	**37**	**15**	**194**	**25**	**15**	**387**	**29**	**19**
Central Asia	60	88	37	21	76	43	9	78	44	32	75	13
East Asia	75	31	1	78	18	5	114	18	10	184	18	7
South Asia	60	75	5	49	55	4	25	36	12	64	14	14
Southeast Asia	29	28	28	41	29	32	46	28	24	107	44	44
Southwest Pacific	**40**	**28**	**28**	**19**	**29**	**32**	**44**	**28**	**24**	**56**	**44**	**44**
Europe and the Caucasus	**957**	**80**	**80**	**327**	**81**	**76**	**334**	**89**	**84**	**1622**	**45**	**38**
Latin America and the Caribbean	**189**	**35**	**80**	**117**	**35**	**81**	**150**	**34**	**89**	**293**	**34**	**45**
Caribbean	24	18	37	22	18	34	26	18	24	24	18	12
Central America	42	5	50	35	5	45	36	5	38	74	5	50
South America	123	5	26	60	5	34	88	5	33	195	5	24
North America	**57**	**100**	**100**	**16**	**100**	**100**	**26**	**96**	**96**	**64**	**84**	**84**
Near & Middle East	**38**	**47**	**29**	**32**	**59**	**41**	**1**	**0**	**0**	**52**	**0**	**0**
World	**1683**	**85**	**72**	**870**	**73**	**55**	**892**	**65**	**54**	**2767**	**44**	**35**

Country report responses related to the implementation of the Global Plan of Action show that approximately 45 percent of countries consider that they have fully implemented baseline surveys for breeds in all livestock species of economic importance. In contrast, almost 20 percent of countries report that no baseline surveys at all have been undertaken in any of their national breed populations. The remaining countries report partial coverage. In the case of monitoring programmes, 30 percent of

countries report full coverage of breeds in all important livestock species, 30 percent report partial coverage and 40 percent report that they have no monitoring activities. Progress since the adoption of the Global Plan of Action has been encouraging, but unspectacular, overall. About 20 percent of countries report that the coverage of their monitoring programmes has increased since 2007. Approximately 30 percent report at least some new baseline surveys. Another point to note from the country-report responses related to the implementation of the Global Plan of Action is that majority of countries (over 60 percent) still regard their breed inventories as being incomplete. In other words, they have not yet identified all the distinct breeds that are present.

With regard to the state of organizational arrangements for monitoring programmes, almost 60 percent of countries report that they have allocated institutional responsibilities for monitoring programmes and about 35 percent that they have established protocols (details of schedules, objectives and methods) for such programmes.

Box 3AB2. China's second national animal genetic resources survey

China's first national survey on AnGR began in 1976. The first phase was completed in 1984 and the results were published between 1986 and 1990. A further phase was implemented in 1995 and 1996, focusing on the southwestern mountainous area and Tibet, which had not been included in the first phase.

During the 1980s, China began to implement a reform and opening-up policy. The importation of exotic breeds and rapid development of intensive and large-scale production systems contributed to an unprecedented improvement in livestock production performances. However, these achievements were accompanied by a great threat to the diversity of China's AnGR. As a result, the Ministry of Agriculture decided to carry out a second national survey. In 2003, the National Commission of AnGR organized experts to draft a technical manual in preparation for the second survey. The following year, four provinces were selected for a pilot survey. After two years of the pilot survey, the Implementation Plan for the National Survey on AnGR was finalized. In 2006, the plan was issued to provinces and regions nationwide by the Ministry of Agriculture, thereby formally launching the second survey.

It is estimated that more than 6 900 people from 30 provinces and autonomous regions nationwide were involved in the survey, with more than 45 million Yuan (ca 7.3 million USD) of central and local funds invested in the survey and the compilation of the findings. More than 1 200 animal breeds were surveyed and 21 300 photos of breeds were taken.

In 2010–2012, *The record of China's animal genetic resources* was finalized and published, based on the survey results. The publication consists of seven volumes and includes more than 2100 pictures. Volumes on bees and on rabbits, deer and fur animals were published for the first time.

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As a result of the survey, a number of previously unrecorded breeds were discovered and identified. These included breeds with distinctive characteristics, such as the Gaoligongshan pig and Piao chicken of the remote southwestern mountainous area. More than 540 indigenous breeds were described, more than twice the number recorded in the first survey.

The second survey revealed the precarious status of China's AnGR. Nearly 300 indigenous breeds had declined in numbers, accounting for more than half of all breeds. Fifteen breeds had died out, 55 were

endangered and 22 were on the brink of extinction, with the latter two categories accounting for 14 percent of the total.

Impacts of the second survey on policies have included the following:

- Since 2012, the annual regular budgetary allocation for the conservation of breeds has increased from 32 million Yuan to 50 million Yuan (more than 8 million USD).
- To date, one in three provinces has launched regular budgetary allocation for the conservation of breeds on provincial priority lists. The annual budget varies from 4 million Yuan to 7 million Yuan (0.6 – 1.1 million USD).
- In 2012, the Ministry of Agriculture issued the Twelfth Five Year Plan on the Conservation and Sustainable Utilization of Animal Genetic Resources, which includes plans to establish a national dynamic monitoring and early warning system.
- In February 2014, the Ministry of Agriculture re-issued the priority list for conservation. The number of breeds on the list has risen to 159.

Provided by Hongjie Yang.

4. Phenotypic and molecular genetic characterization

The level of implementation of various types of phenotypic and molecular genetic characterization study in the big five species is summarized in Figure 3AB2 and Table 3AB4. Because it was likely to be difficult for countries to provide precise information on the number of breed populations subject to specific types of study, the country report questionnaire requested them to score the level of coverage, as follows: high (approximately >67 percent of breeds); medium (approximately 33 to 67 percent of breeds); low (approximately <33 percent of breeds); or none (no coverage). Figure 3AB2 shows the proportion of answers falling into each category, broken down on the left by species and on the right by region. Table 3AB4 presents a summary of the same data based on the average level of implementation at regional level. These presentations reveal large gaps in the coverage of characterization studies. For almost all combinations of species and type of study, a majority of countries report either no coverage or low coverage. Phenotypic characterization has been more widely implemented than the other activities. Across all categories, dairy cattle are more likely to have high or medium levels of coverage than other species (and other types of cattle). North America (represented by the United States of America only), and Europe and the Caucasus, have higher levels of coverage than other regions, but many gaps in coverage remain even in these regions.

As described above, providing information on characterization activities targeting breeds other than the big five was not a compulsory element of the country-reporting process. Nevertheless, countries had the option of providing information on these species (equivalent to that provided for the big five). Results for buffaloes, horses, asses, dromedaries, rabbits, ducks, turkeys, geese and guinea fowl are shown in Figure 3AB3. As with Figure 3AB2, the bar charts indicate the proportion of responses (equivalent here to the proportion of countries) corresponding to each level of implementation. As providing information was not obligatory, a number of countries that reported the presence of a given species provided no indication of the level of implementation of characterization studies. The bar charts, therefore, in contrast to those for the big five, include a “no answer” category. The figure shows that, as in the case of the big five species, many gaps remain in the coverage of characterization studies. Phenotypic characterization has, again, been relatively widely implemented. Across the range of different activities, characterization of horses, and with some exceptions buffaloes, is more advanced than that of other species.

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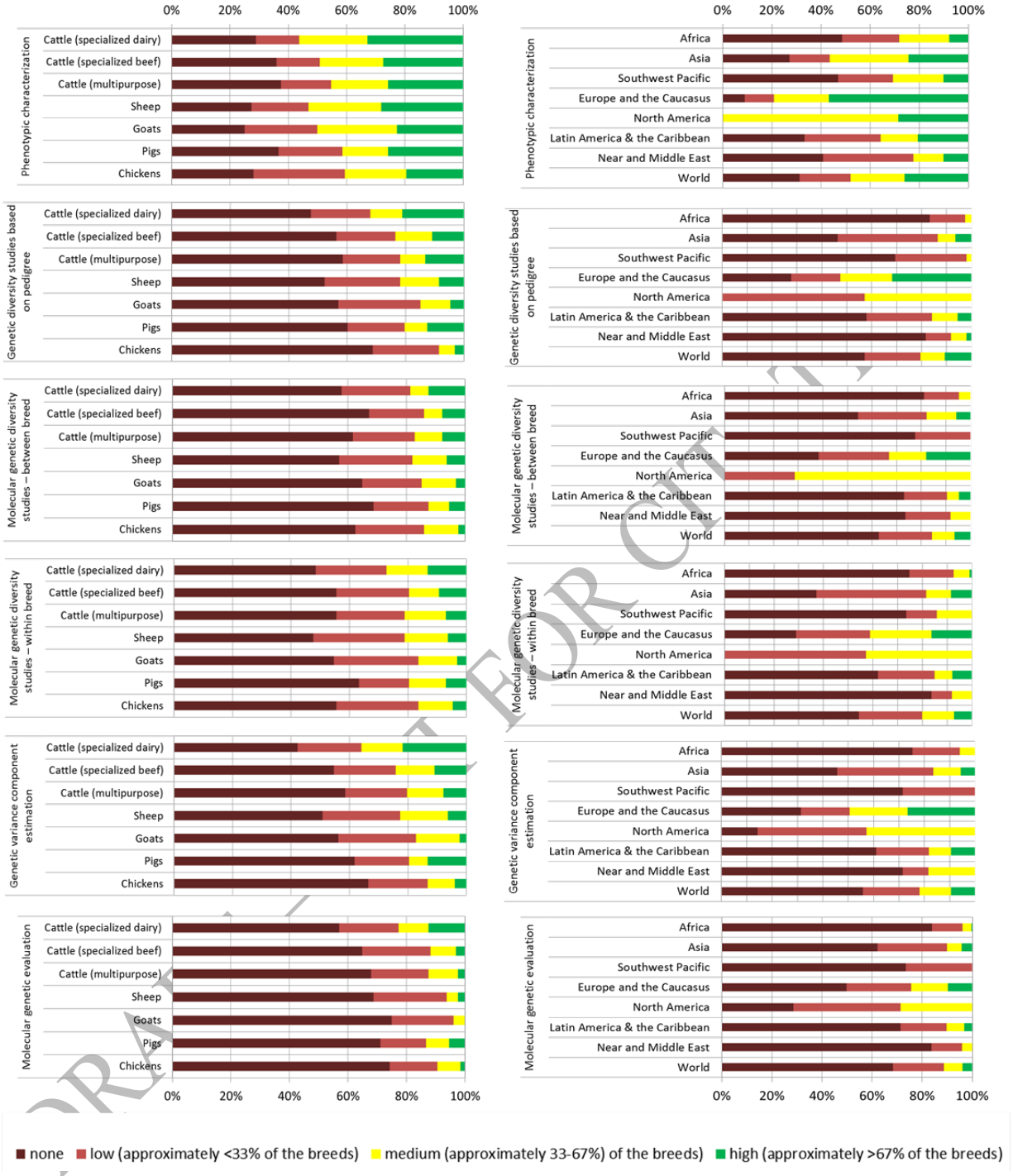
Figure 3AB2. Level of breed coverage in characterization activities for the big five species – regional and species breakdowns showing frequency of responses



Notes: The bar charts show the proportion of responses falling into the none, low, medium and high categories of breed coverage (see legend). The charts on the left show the overall proportion of countries that provided the respective response for the respective species. The charts on the right, show the proportion of answers (country × species combinations) from the respective region falling into the respective category.

Table 3AB4. Level of breed coverage in characterization activities for the big five species – regional and species breakdown based on average scores

Activity	Species	Africa	Asia	Southwest Pacific	Europe and the Caucasus	Latin America & the Caribbean	North America	Near and Middle East	World
Phenotypic characterization	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								
Genetic diversity studies based on pedigree	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								
Molecular genetic diversity studies – between breed	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								
Molecular genetic diversity studies – within breed	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								
Genetic variance component estimation	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								
Molecular genetic evaluation	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								

Notes: Scores provided by countries were converted into numerical values (none = 0; low = 1; medium = 2; high = 3). The colours indicate average scores for the countries of the respective region, as shown in the legend (border values assigned to the higher class).

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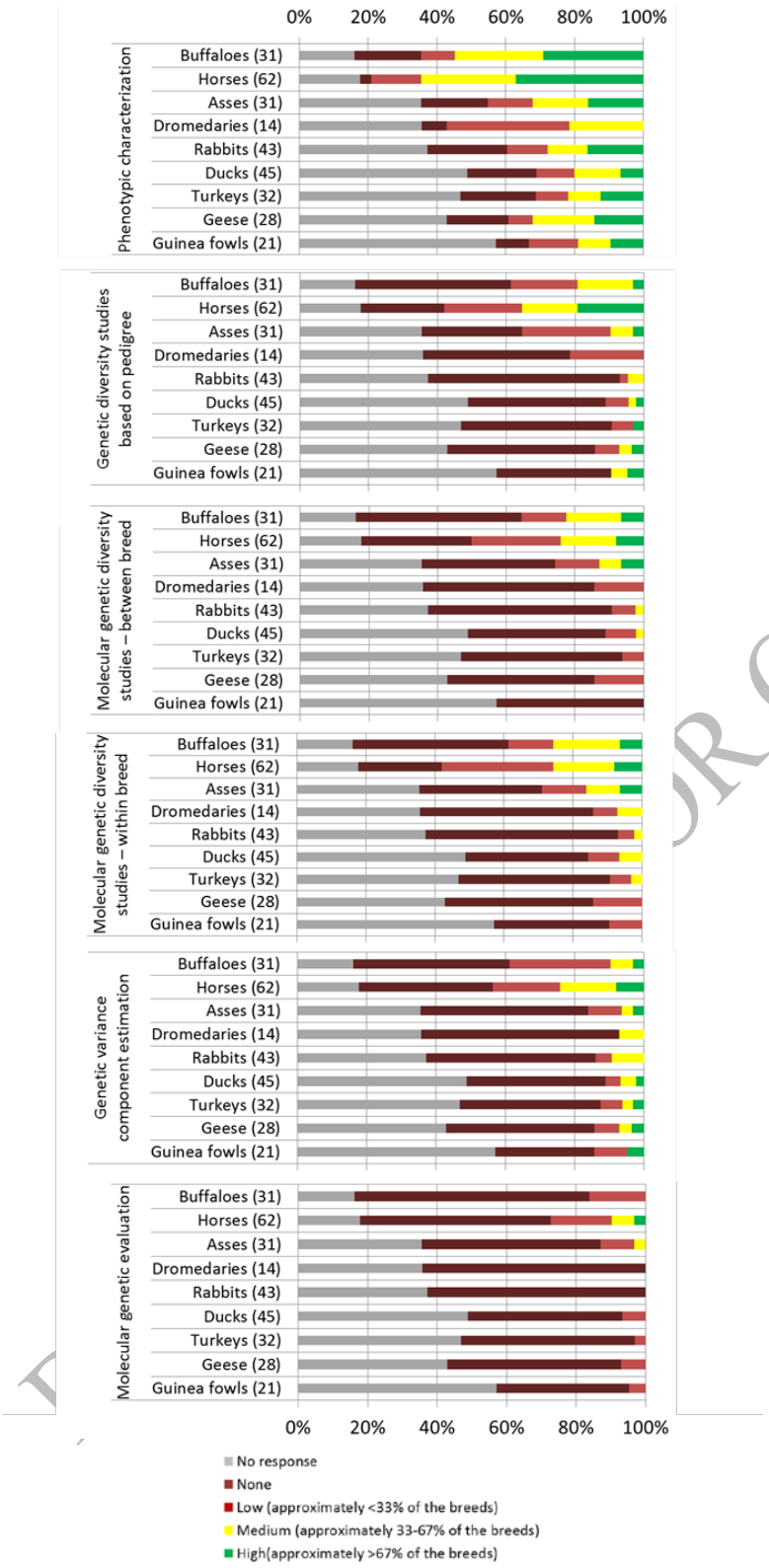
Country reporting on the implemention of the Global Plan of Action indicates that many countries have made progress in AnGR characterization since 2007. In the case of both phenotypic and molecular genetic characterization, the majority of countries either report improvements or report that comprehensive studies had already been undertaken before 2007. Unfortunately, a substantial minority of countries remain at a low level of coverage and have not made any improvements in recent years. Both the extent of coverage and the extent of progress are lower in the case of molecular genetic studies than in the case of phenotypic studies.

Figure 3AB3. Level of breed coverage in characterization activities for "minor" species



Notes: The figures refer only to countries that reported the presence of the respective species (number shown in brackets on the left for each species).The bars show the proportion of countries whose responses fell into the none, low, high and medium categories or that provided no information on the state of characterization in respective species.

5. Constraints to characterization, surveying and monitoring

As noted above, the country report questionnaire requested countries to provide information on the major barriers and obstacles preventing them from improving their inventory, characterization and monitoring programmes. Lack of funding was the most commonly mentioned constraint, followed by a lack of human capacity (technical skills and knowledge). Other constraints mentioned included lack of infrastructure and technical resources (including for data management); lack of awareness on the part of policy-makers and livestock keepers; and lack of adequate policies and planning in the field of characterization, surveying and monitoring. Some countries mentioned practical difficulties associated with the large size of the country or the location of livestock in remote areas, on small farms or in mobile production systems. A few countries mentioned problems associated with a lack of coordination – or lack of willingness to share information – among stakeholders (e.g. breeders' associations and private companies).

6. Conclusions and priorities

In most regions of the world, there are major gaps in the coverage of characterization activities and hence major gaps in knowledge about the characteristics of AnGR. Similarly, there are major gaps in programmes for monitoring trends in breed population and hence the current risk status of many breeds is unknown. These gaps in knowledge inevitably hamper the sustainable use, development and conservation of AnGR. Weaknesses are particularly marked in the developing regions of the world.

Strategic priorities for improving the state of inventory, characterization and monitoring are set out in the Global Plan of Action, which recognizes the fundamental importance of improving the state of knowledge of AnGR. Many countries have made some progress in implementing these priorities. However, progress is often constrained by a lack of human and financial resources. The need to strengthen capacity in this field is recognized in the Global Plan of Action as follows:

> *"Establish or strengthen, in partnership with other countries, as appropriate, relevant research, training and extension institutions, including national and regional agricultural research systems, to support efforts to characterize, inventory and monitor trends and associated risks, sustainably use and develop, and conserve animal genetic resources".*[1]

The evidence from the country reports suggests that this action remains highly relevant. Lack of funding is a widespread constraint to improving many aspects of the management of AnGR. The Global Plan of Action recognizes both the need for "substantial and additional financial resources" and the need for predictable allocation of such resources. The latter may be particularly significant for ongoing activities such as monitoring programmes. Unfortunately, the country reports indicate that improving funding is one of the elements of the Global Plan of Action for which least progress has been made to date.

While monitoring programmes are far from comprehensive in terms of breed coverage, in most species a majority of national populations are reported to be subject to regular population monitoring. Here there appears to be a discrepancy with the level of reporting of breed population data at international level, i.e. the entry by countries of their national data into the Domestic Animal Diversity Information System (DAD-IS) (see Part 1 Section 2). For example, 78 percent of national breed population figures in DAD-IS were not updated once during the four years preceding the preparation of the second SoW-AnGR (FAO, 2014b). If data are available at national level, it is important that they are entered into DAD-IS, so as to allow global trends to be monitored more effectively.

Another issue that may require attention is the institutional framework for the surveying and monitoring of AnGR. The Global Plan of Action recognizes the need to "encourage the establishment of institutional responsibilities and infrastructure for monitoring of trends ...". Establishing an effective surveying and monitoring programme requires not only funds and human resources, but also clear

[1] Strategic Priority 13, Action 3.

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allocation of responsibilities for overall coordination and for specific tasks (organization of surveys, provision of data to national authorities, etc.). Objectives, relevant to national data requirements and feasible in terms of national capacities, need to be defined and support from stakeholders needs to be ensured. The country reports indicate that some progress has been made in terms of improving institutional arrangements for surveying and monitoring, but that large gaps remain. Advice on the development of national strategies in this field, including institutional arrangements and stakeholder involvement, is provided in the FAO guidelines *Surveying and monitoring of animal genetic resources* (FAO, 2011b). The guidelines *Phenotypic characterization of animal genetic resources* and *Molecular genetic characterization of animal genetic resources* (FAO, 2011a, 2012) also provide advice on how to ensure that characterization studies are relevant to national requirements for data to improve AnGR management. All three guidelines provide practical advice on the organization of characterization and monitoring activities.

The country reports reveal gaps in implementation across all the activities discussed in this section. Specific priorities for action will depend on national circumstances. However, in many countries the basic task of establishing a full inventory of national breeds has not been completed. Similarly, for many recognized breeds, phenotypic characteristics – morphology, performance in specific production environments, degree of adaptedness to specific diseases or climatic challenges, and so on – have been inadequately studied. Gaps are particularly prominent in developing countries, which means that the characteristics of the locally adapted breeds of these countries have been particularly poorly characterized and that the comparative performance of different breeds in the production conditions of these countries has been inadequately assessed. If these gaps are not addressed, it will be difficult or impossible to manage locally adapted breeds sustainably and ensure that their potential is realized.

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SECTION B. BREEDING PROGRAMMES

1. Introduction

Based on the information provided in the country reports, this section presents an analysis of the state of implementation of livestock breeding programmes and of capacity to implement them. The state of the art in breeding programmes is described separately in Part 4 Section [crossref]. Breeding programmes were defined in the country-report questionnaire as follows:

> *"systematic and structured programmes for changing the genetic composition of a population towards a defined breeding goal (objective) to realize genetic gain (response to selection), based on objective performance criteria.*
> *Breeding programmes typically contain the following elements:*
> - *definition of breeding goal;*
> - *identification of animals;*
> - *performance testing;*
> - *estimation of breeding values;*
> - *selection;*
> - *mating; and*
> - *transfer of genetic gain.*
>
> *Breeding programmes are usually operated either by a group of livestock breeders organized in a breeders' association, community-based entity or other collective body; by a large commercial breeding company; or by the government."*

In addition to reporting on programmes of this type, countries also provided information on other activities and strategies aimed at improving the quality of their livestock populations in genetic terms, i.e. measures taken to promote cross-breeding or the wider use of breeds perceived to be more productive.

The intention of this section is to provide an update of the material presented in the first report on *The State of the World's Animal Genetic Resources for Food and Agriculture* (first SoW-AnGR). The country-report questionnaire addressed the main themes covered in the first SoW-AnGR. However, because of the different reporting methods, most of the findings presented below are not directly comparable to those presented in the earlier publication.

2. Global overview

For each of the so-called "big five" species (cattle, sheep, goats, pigs and chickens), the majority of countries indicate the presence of breeding programmes (Table 3B1). The figures are higher for cattle (around 90 percent each for the dairy, beef and multipurpose categories) than for the other species (around 80 percent in all cases). While the figures appear to show that breeding programmes are widespread, in some cases the activities referred to in the country reports do not seem to be breeding programmes in the strict sense of the term (see above). Many countries report the presence of breeding programmes, but also that some of the key elements of breeding programmes are not in place for any of their breeds. For this reason, the figures presented in the table need to be treated with some caution. It should also be noted that the figures merely indicate the presence of at least one programme targeting the respective species. The numbers of breeds covered may be high or low, as may the effectiveness and reach of the programmes.

Table 3B1 presents a breakdown of the figures by region and by species. Programmes for beef and dairy cattle are widespread in almost all regions and subregions (dairy cattle programmes in North and

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West Africa are the main exception). Gaps are more widespread in the case of multipurpose cattle (e.g. in South Asia, the Near and Middle East and Central America) and even more so in other species (e.g. sheep, pigs and chickens across most subregions of Africa; sheep and goats in East Asia and the Southwest Pacific).

Table 3B1. Proportion of countries reporting the existence of breeding programmes

Regions and subregions	Number of countries	Dairy cattle	Beef cattle	Multipurpose cattle	Sheep	Goats	Pigs	Chickens
		%						
Africa	**40**	76	90	82	58	75	57	56
East Africa	8	88	100	86	50	88	50	63
North & West Africa	20	57	83	83	60	60	56	42
Southern Africa	12	92	91	78	58	92	64	75
Asia	**20**	95	89	80	74	80	75	85
Central Asia	4	100	100	100	100	100	50	100
East Asia	4	100	75	100	50	50	75	75
South Asia	6	100	100	60	80	83	100	83
Southeast Asia	6	83	83	75	67	83	67	83
Southwest Pacific	**7**	100	100	100	67	40	86	86
Europe & the Caucasus	**35**	97	88	97	97	94	97	94
Latin America & the Caribbean	**18**	100	100	80	94	89	100	83
Caribbean	5	100	100	75	100	100	100	60
Central America	5	100	100	60	100	100	100	80
South America	8	100	100	100	88	75	100	100
North America	**1**	100	100	100	100	100	100	100
Near & Middle East	**7**	83	100	67	86	71	0	86
World	**128**	91	93	87	79	81	80	79

Note: The figures and bars represent the number of countries indicating the presence of breeding programmes (at least one) as a proportion of the number of countries reporting the presence of the respective species.

In the case of species other than the big five, the proportion of countries indicating that they have breeding programmes in place is generally low (Table 3B2). Only in the case of horses (74 percent) and buffaloes (58 percent) and Bactrian camels (80 percent), do the majority of countries reporting the presence of the respective species indicate that they have breeding programmes in place (see Table 3B2).

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Table 3B2. Proportion of countries reporting the existence of breeding programmes

Species	Number of countries reporting presence	Percentage of countries with breeding programmes (at least one)
Dairy cattle	116	91
Beef cattle	103	93
Multipurpose cattle	103	87
Sheep	123	79
Goats	126	81
Pigs	112	80
Chickens	126	79
Horses	62	74
Ducks	43	40
Rabbits	43	44
Buffaloes	31	58
Turkeys	31	45
Asses	30	0
Geese	28	43
Guinea fowls	20	30
Dromedaries	14	29
Quails	14	36
Ostriches	13	31
Pigeons	11	9
Deer	8	0
Alpacas	7	0
Llamas	6	33
Muscovy ducks	6	33
Bactrian camels	5	80
Yaks	5	40
Guinea pigs	4	0

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3. Stakeholder involvement

Stable organizational structures are needed to enable the systematic implementation of breeding programmes. Programmes can be organized by public-sector bodies, by the private sector, by non-governmental organizations (NGOs) or via collaborative efforts involving more than one sector. Table 3B3 summarizes the information provided in the country reports regarding the sectors and groups of stakeholders that operate breeding programmes (i.e. take the leading or organizational role in the operation of such programmes). For the purposes of this analysis, the private and non-governmental sectors are divided into the following categories:

- national commercial companies (companies based in the respective reporting country),
- external commercial companies (companies based outside the reporting country);
- breeders' associations or cooperatives (membership organizations in which individual livestock breeders join together to pursue common goals);
- NGOs (NGOs that are not breeders' associations: e.g. those involved in promoting rural development); and

- livestock keepers organized at community level (community-level structures, whether traditional or newly established, that enable livestock keepers to act collectively organize genetic improvement activities).

At global level, the most frequently reported operators of breeding programmes are the government and breeders' associations. However, there are major differences between regions in terms of the reported significance of these two categories. Breeders' associations are frequently reported in Europe and the Caucasus and North America, but much less so in most developing regions. Latin America and the Caribbean is a partial exception, or more specifically Central and South America. Conversely, government-operated programmes are reported more frequently in all developing regions (most particularly in Asia and the Near and Middle East) than in Europe and the Caucasus and North America (represented in the country reporting only by the United States of America). No government-operated programmes are reported in the latter region). Programmes operated by national and external commercial companies are reported from all regions of the world (most frequently in the Southwest Pacific, North America, and Central and South America). The species involved are most commonly chickens, pigs or dairy cattle (see Annex A3B1, A3B6, A3B7). Programmes operated by livestock keepers organized at community level are quite widely reported across all developing regions. However, the country reports generally provide little information about the nature of these programmes. Programmes operated by NGOs are reported in most regions, but generally with relatively low frequency (highest levels in Central America, the Southwest Pacific and Central Asia).

Table 3B3. Extent of involvement of different stakeholder groups as operators of breeding programmes

Regions and subregions	Number of countries	Government	Livestock keepers organized at community level	Breeders' associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**40**	52	29	32	17	6	15	9
East Africa	8	58	24	26	15	4	13	7
North & West Africa	20	49	28	37	11	9	19	8
Southern Africa	12	54	33	29	28	4	11	10
Asia	**20**	83	38	43	30	22	28	11
Central Asia	4	94	60	40	40	37	40	0
East Asia	4	75	29	43	36	39	29	0
South Asia	6	83	45	26	16	0	37	6
Southeast Asia	6	77	23	57	32	20	13	30
Southwest Pacific	**7**	47	40	45	45	60	43	6
Europe & the Caucasus	**35**	37	9	76	25	20	17	14
Latin America & the Caribbean	**18**	60	33	57	55	26	29	25
Caribbean	5	70	29	15	24	13	3	3
Central America	5	60	29	74	80	17	54	20
South America	8	54	38	72	59	40	29	41
North America	**1**	0	71	100	86	57	0	100
Near & Middle East	**7**	78	43	20	24	20	24	18
World	**128**	54	27	51	29	19	21	14

Note: The figures refer to the percentage of national species populations – taking into account the "big five" species (cattle, sheep, goats, pigs and chickens), with the three categories of cattle breeds (dairy, beef and multipurpose) treated separately – in which the respective stakeholder group operates breeding programmes, i.e. the potential maximum involvement of any stakeholder group is in 896 national populations (7 "species"× 128 countries).

Whatever sector takes the leading role in organizing a breeding programme, a range of different tasks needs to be addressed. A variety of different stakeholders may be involved in each of these tasks, either in terms of planning (e.g. identifying breeding goals and planning how the programme will be organized) or in terms of practical implementation (e.g. recording animals' performance, undertaking genetic evaluations or delivering artificial insemination services). These activities can be thought of as the "building blocks" of breeding programmes. Some of these building blocks can serve a number of different purposes, i.e. they can contribute not only to breeding programmes, but also to other aspects of livestock development. For example, animal identification can facilitate disease control, prevention of livestock theft and the delivery of support payments (FAO, 2014). Performance recording can play a role in herd management. Thus, the building blocks may be in place even if no breeding programmes are yet in operation.

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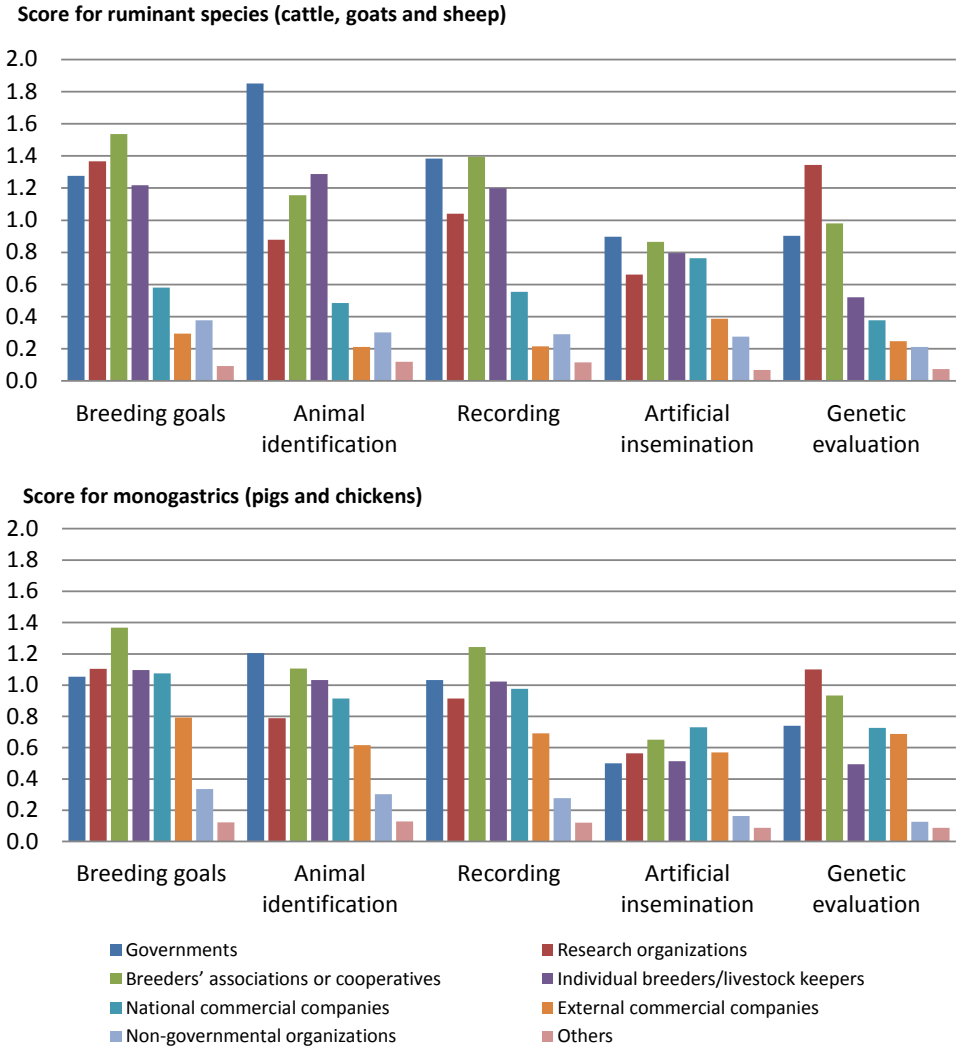
Countries were asked both to provide information on the level of implementation of the various building blocks of breeding programmes (Figure 3B1) and to report on the level of involvement of different stakeholders in their implementation. Because some of these activities can be undertaken by individual livestock keepers, and because of the prominent role of research organizations in undertaking some of them, these two stakeholder categories were included in the list of options provided in the country-report questionnaire. Countries were asked to provide scores for the level of involvement of the various categories. The responses (with respect to the big-five species) are summarized in Figure 3B1.

Figure 3B1. Levels of reported stakeholder involvement in breeding-related activities in ruminants and monogastrics – global averages



Notes: Each country provided a score for the level of stakeholder involvement in each activity. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).

Governments, research organizations, breeders' associations and individual livestock are reported to play relatively prominent roles across all activities, both in ruminants and monogastrics. In the case of commercial companies, involvement in most activities is markedly higher in monogastrics and dairy cattle than in other types of livestock, although national commercial companies are among the main providers of artificial insemination services. The role of NGOs is limited across all categories of activity. The global figures conceal some regional differences. As in the case of the figures presented in Table 3B3, the roles of breeders' associations are generally more prominent than those of governments in developed regions, while the opposite is the case in developing regions. The role of commercial companies is more prominent in North America than in other regions. However, they are also widely reported as operators of breeding programmes in Central and South America (particularly

national companies), the Southwest Pacific (particularly external companies) and, somewhat less frequently, in Europe and the Caucasus, East, Central and Southeast Asia and the Near and Middle East.

4. Educational, research and organizational capacities

The successful development and operation of breeding programmes requires a high level of technical capacity and knowledge on the part of the stakeholders involved. Many countries mention limited knowledge on the part of livestock keepers and technicians as a significant constraint to the implementation of breeding programmes. The general state of AnGR-related education and training is discussed in Section [crossref]. However, countries were asked specifically to provide scores (none, low, medium or high) for the state of education and training in the field of animal breeding. The responses are summarized in Figure 3B2. The global cumulative score of 12 out of a potential maximum of 21 illustrates that there is a major deficit in the provision of education and training in this field. Africa and the Near and Middle East[1] are the regions reporting the lowest levels of provision. Responses related to the state of implementation the Global Plan of Action for Animal Genetic Resources reveal a similar picture (Figure 3B3). Approximately 31 percent of reporting countries consider that their provision of training and technical support programmes for the breeding activities of livestock-keeping communities is at an adequate level. 43 percent report that they have some programmes of this type in place, but that they require improvement. 26 percent report that they have no training and technical support programmes related to breeding. About 39 percent report that they have made no progress in terms of improving provisions since the Global Plan of Action was adopted in 2007 (Figure 3B3).

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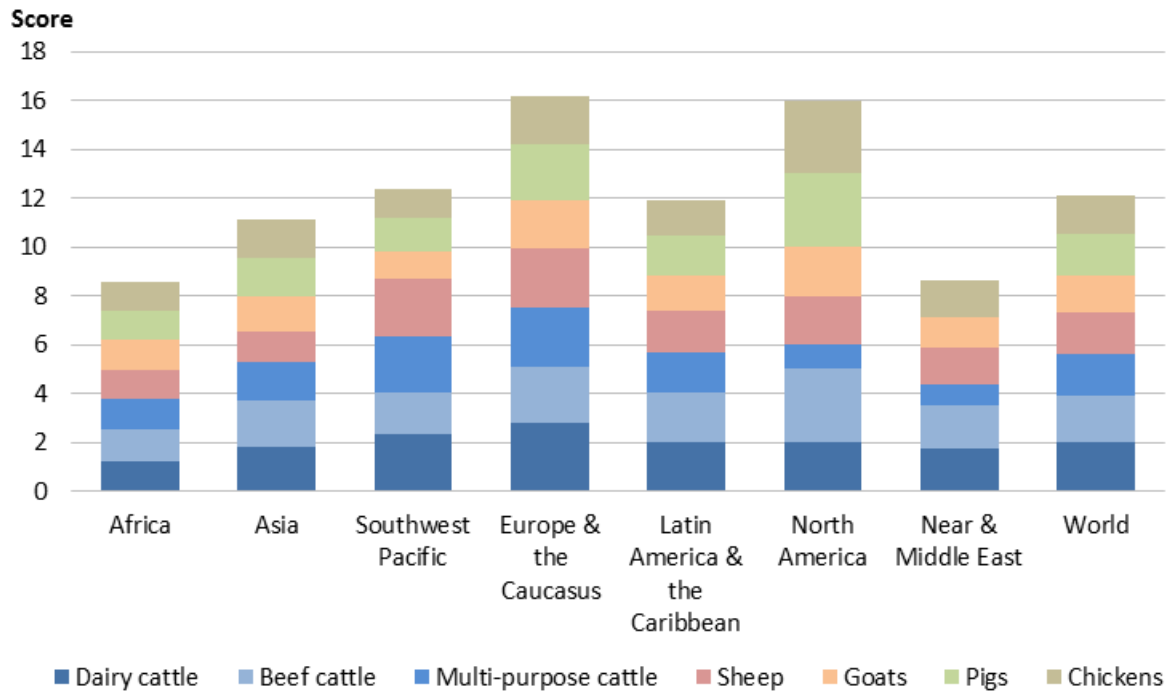
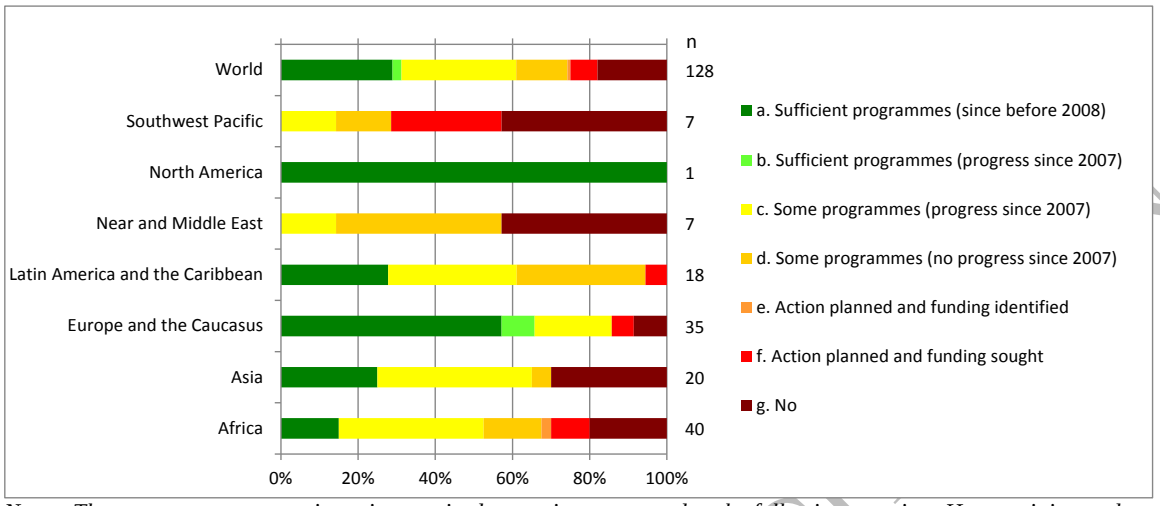
Figure 3B2. Average reported state of training in the field of animal breeding in the main livestock species per region



[1] The cumulative score for the Near and Middle East is affected by the complete absence of provisions related to pigs, a species that is of very minor significance in the region. This in effect biases the region's score downwards. However, even if pigs were omitted from the analysis, the region would still have among the lowest reported levels of provision.

Notes: Each country provided a score for the level of provision with respect to each species. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3). The length of each bar corresponds to the cumulative score across all species for the respective region. The maximum potential score is 21 (3×7).

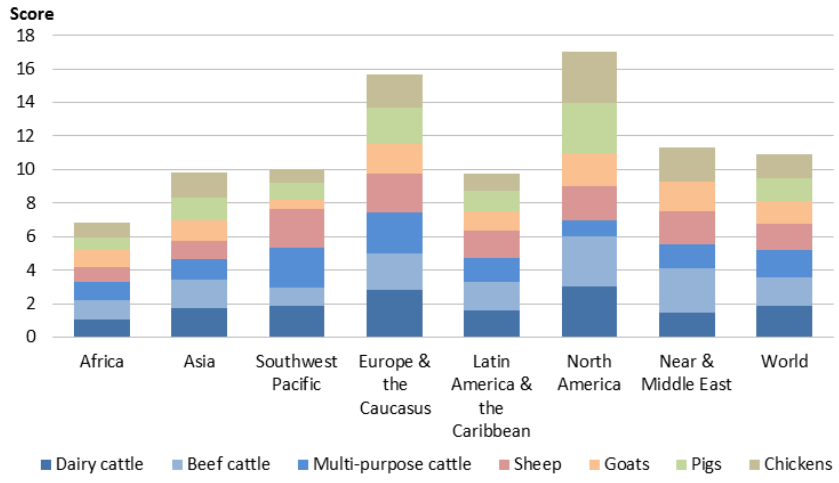
Figure 3B3. State of implementation of training and technical support programmes for the breeding activities of livestock-keeping communities



Notes: The country-report questionnaire required countries to respond to the following question: Have training and technical support programmes for the breeding activities of livestock-keeping communities been established or strengthened in your country?

Countries were also asked to report on the state of their research activities in the field of animal breeding, again by providing a score. The responses are summarized in Figure 3B4. On a global scale, as in the case of training, there is a major gap between the current level of research activity and the potential maximum (high level of research in all countries for all species). In practice, the effect of this shortfall is likely to be reduced by the diffusion of research results from one country to another. However, the concentration of research in certain regions or countries may increase the likelihood that some production systems and species are inadequately researched. Moreover, there may be constraints to the diffusion of knowledge, particularly into less-developed countries. Scores for the state of research are highest in North America and Europe and the Caucasus, and lowest in Africa.

Figure 3B4. Average reported state of research in the field of animal breeding in the main livestock species per region



Notes: Each country provided a score for the level of provision with respect to each species. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3). The length of each bar corresponds to the cumulative score across all species for the respective region. The maximum potential score is 21 (3×7).

As noted above, breeding programmes are complex undertakings that involve a range of different tasks. Establishing a successful breeding programme requires not only the technical capacity to undertake these tasks, but also organizational structures that enable these tasks to be carried out systematically and on a sufficiently large scale. They are likely to require the organized involvement of livestock keepers. Countries were asked to report (again by providing a score) on the state of livestock-keeper organization with respect to the various elements of breeding programmes. The responses are summarized in Table 3B4. Scores for the level of organization are highest in Europe and the Caucasus, Latin America and the Caribbean and North America and lowest in Africa, the Southwest Pacific and the Near and Middle East.

Table 3B4. Reported level of organization of livestock keepers with respect to the operation of breeding programmes and the elements of breeding programmes

Regions and subregions	Number of countries	Dairy cattle	Beef cattle	Multipurpose cattle	Sheep	Goats	Pigs	Chickens
Africa	**40**	0.8	0.6	0.8	0.7	0.7	0.6	0.7
East Africa	8	0.9	0.6	0.6	0.3	0.6	0.4	0.9
North & West Africa	20	0.6	0.5	1.0	0.7	0.7	0.6	0.6
Southern Africa	12	1.0	0.8	0.6	0.8	0.8	0.7	0.7
Asia	**20**	1.5	1.1	0.6	0.9	1.0	1.2	1.3
Central Asia	4	1.5	0.5	1.0	1.3	1.0	0.3	1.3
East Asia	4	2.5	2.3	0.5	1.0	1.3	2.3	1.8
South Asia	6	0.7	0.2	1.0	0.5	0.7	0.5	0.8
Southeast Asia	6	1.5	1.7	0.0	1.0	1.2	1.7	1.5
Southwest Pacific	**7**	0.7	0.9	0.6	0.7	0.7	1.1	1.1
Europe & the Caucasus	**35**	2.7	2.3	1.9	2.4	1.9	2.2	1.7
Latin America & the Caribbean	**18**	1.9	1.5	0.9	1.4	1.1	1.3	1.4
Caribbean	5	1.8	0.4	0.2	1.2	1.2	1.2	1.0
Central America	5	1.6	1.6	1.2	1.2	1.4	1.4	1.4
South America	8	2.1	2.1	1.1	1.6	0.9	1.4	1.8
North America	**1**	3.0	3.0	2.0	2.0	2.0	3.0	1.0
Near & Middle East	**7**	0.6	0.1	0.3	0.6	0.4	0.0	0.9
World	**128**	1.6	1.3	1.1	1.3	1.1	1.2	1.2

Notes: Each country provided a score for the level of provision with respect to each species. The scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3). The figures shown in the table are average scores for the countries of the respective region.

5. Breeding methods and activities

An overview of the status of breeding programmes is presented above (Subsection 2). This subsection presents an analysis of the level of implementation of the various elements of breeding programmes and of the types of programmes that are in operation, specifically the prevalence of programmes that involve cross-breeding.

Countries were asked to indicate the number of exotic and locally adapted breed populations for which breeding goals have been defined and in which the following activities are being implemented:

- animal identification: recording of pedigrees;
- recording of animal performance; use of artificial insemination (AI);
- implementation of genetic evaluation following the classic approach (i.e. not including the use of genomic information);
- implementation of genetic evaluation including the use of genomic information: and
- management of genetic variation by maximizing the effective population size or minimizing the rate of inbreeding.

The findings are presented in Table 3B5 (broken down by region), in Table 3B6 (broken down by species) and in Annex 2.

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Table 3B5. Level of implementation (proportion of national breed populations covered) of breeding-programme elements and techniques (regional breakdown)

Regions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	671	646	48	45	30	29	22	26	37	28
Asia	374	949	48	33	31	24	40	30	40	24
Southwest Pacific	150	66	47	66	41	56	39	61	40	32
Europe & the Caucasus	2051	2039	58	78	47	74	41	70	33	32
Latin America & the Caribbean	690	474	37	50	36	35	30	31	31	32
North America	19	222	26	69	26	51	26	46	26	49
Near & Middle East	69	99	30	26	23	16	28	16	20	19
World	4024	4495	51	59	40	51	36	49	35	30

Regions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	671	646	34	39	15	24	9	6	16	13
Asia	374	949	47	26	21	22	6	7	13	11
Southwest Pacific	150	66	48	70	61	54	61	54	53	57
Europe & the Caucasus	2051	2039	55	73	29	47	5	8	26	51
Latin America & the Caribbean	690	474	28	30	12	27	4	4	5	8
North America	19	222	26	98	26	40	26	34	26	58
Near & Middle East	69	99	30	18	19	16	1	15	12	5
World	4024	4495	45	53	24	35	8	9	20	32

Notes: The figures refer to breeds belonging to the big-five species (cattle, goats, sheep, pigs and chickens). They indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

Table 3B6. Level of implementation (proportion of national breed populations covered) of breeding-programme elements and techniques (species breakdown)

Species	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Dairy cattle	348	225	69	81	56	68	54	64	81	73
Beef cattle	558	540	76	81	63	76	55	64	65	59
Multipurpose cattle	165	471	84	49	63	37	47	38	78	47
Sheep	605	1078	76	73	65	65	49	60	28	24
Goats	342	528	61	62	47	46	44	42	27	19
Pigs	401	491	53	56	50	45	47	46	50	33
Chickens	1605	1162	23	43	12	36	14	39	10	13

Species	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Dairy cattle	348	225	45	66	29	54	14	26	29	42
Beef cattle	558	540	54	66	34	51	13	17	25	38
Multipurpose cattle	165	471	61	37	34	28	24	7	33	27
Sheep	605	1078	60	60	36	41	7	4	31	39
Goats	342	528	49	44	26	27	8	4	25	31
Pigs	401	491	51	45	33	36	11	13	25	29
Chickens	1605	1162	33	50	10	25	3	4	9	26

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

The figures presented in the tables show that no breeding goal has been defined for almost half of all reported national breed populations. There are also major gaps in the breed coverage of other fundamental breeding-programme elements such as animal identification and pedigree and performance recording. Even where activities are reported, their impacts may be limited. The figures

give no indication of the level of coverage within the breed population. Given that the management of locally adapted breeds is generally regarded as being neglected relative to that of exotic breeds, it is interesting to note that in many cases (i.e. species × technique) coverage is higher among locally adapted breeds than among their exotic counterparts. Two points should be noted in this regard. First, where continuously imported exotic breeds (see Box 3B2) are concerned, the national population is likely to benefit from the effects of breeding programmes operating in other countries, i.e. it may be considered that there is no need to establish a breeding programme at national level (the disadvantage may be a lack of fine-tuning to the needs of local production systems).[2] Second, some of the exotic breeds reported may be present in very small numbers, having been imported by hobbyists or on an experimental basis. These populations may not be intended for use as production animals and therefore the absence of breeding programmes for them may not be particularly significant.

Across almost all the activities covered in Table 3B5, Europe and the Caucasus, North America and the Southwest Pacific[3] are well ahead of the other regions in terms of breed coverage, at least where locally adapted breeds are concerned. Artificial insemination is a partial exception to this rule, a fact that is probably explained in part by the species imbalance in the regional figures, i.e. the developed regions have relatively more breeds belonging to species other than cattle. The use of genomic information in genetic evaluation is reported to be very limited everywhere except the Southwest Pacific (i.e. New Zealand) and North America. The species breakdown (Table 3B6) shows that for most of the activities described the highest coverage is in dairy cattle, beef cattle and sheep breeds. Artificial insemination is again an exception, with multipurpose cattle and pigs having higher coverage than sheep. Chicken breeds have relatively low levels of coverage across all activities, reflecting the domination of the chicken subsector by a few high-output breeds and the large number of breeds raised either in backyard systems or as fancy birds.

Countries were also asked to indicate the prevalence (in terms of the number of exotic and locally adapted breed populations covered) of breeding programmes involving straight-breeding only and those involving both straight-breeding and cross-breeding. The responses are summarized for the big-five species in Table 3B7. As in the case of the overview figures presented above (Subsection 2) the figures in both categories may be overestimates if a strict definition of the term "breeding programme" is applied. While it is clear that cross-breeding strategies are being pursued in all the regions of the world, in all species and in both breed categories, the nature of these strategies and the extent to which they are linked to straight-breeding programmes breeds is not always apparent.

The descriptions provided in the country reports indicate that a strategy of cross-breeding locally adapted breeds or "non-descript" populations with exotic breeds (often through the use of artificial insemination) is being widely pursued in developing countries. In many cases this strategy is being promoted by the country's government as a means of rapidly increasing national output of livestock products. Well-planned cross-breeding can be an effective means of pursuing this objective. However, if not well-planned, the anticipated benefits may not be realized. The extent to which the cross-breeding activities referred to in the country reports form part of organized strategies is not always clear, neither is the extent to which such strategies, where they are in place, are effectively implemented. Consequences in terms of production levels (and in terms of livelihoods, genetic diversity and the environment) are also often unmonitored. In all developing regions a large proportion of countries (75 percent in Africa, 50 percent in Asia, 85 percent in the Southwest Pacific, 70 percent in Latin America and the Caribbean and 85 percent in the Near and Middle East) report that they have not undertaken an assessment of the impact of the use of exotic breeds.[4]

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[2] Some locally adapted breeds are present in more than one country. However, international transfers of "improved" breeding animals and genetic material are dominated by a limited number of breeds. In the case of local breeds (present in only one country) as opposed to transboundary breeds, importing genetic material is not an option, as far as straight-breeding is concerned.

[3] New Zealand accounts for 56 percent of all the breeds (of cattle, sheep, goats, pigs and chickens) reported from the region and almost all of them are covered by the various breeding-programme elements

[4] Figures refer to responses to a specific question addressing this topic included in the section of the country report questionnaire addressing the state of implementation of the Global Plan of Action.

Table 3B7. Proportion of breeds reported to be subject to breeding programmes applying straight/pure-breeding and cross-breeding

Straight/pure-breeding only	Dairy cattle		Beef cattle		Multipurpose cattle		Sheep		Goats		Pigs		Chickens	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
	%													
Africa	38	30	51	46	70	24	24	39	26	38	30	33	25	39
Asia	32	42	15	30	57	43	19	55	24	33	44	17	28	31
Southwest Pacific	10	33	12	38	22	100	0	7	0	0	8	17	0	36
Europe & the Caucasus	42	64	54	48	32	55	54	51	56	56	47	42	12	41
Latin America & the Caribbean	43	53	38	43	0	23	26	27	14	14	20	11	6	27
North America	0	0	0	0	n/a	0	n/a	0	n/a	0	0	0	0	0
Near & Middle East	17	29	0	50	25	13	14	21	27	38	n/a	0	26	21
World	38	48	43	39	40	39	40	45	35	39	35	27	14	35
Straight/pure-breeding and crossbreeding	**Dairy cattle**		**Beef cattle**		**Multipurpose cattle**		**Sheep**		**Goats**		**Pigs**		**Chickens**	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
	%													
Africa	57	58	77	54	80	30	36	23	40	32	46	35	25	36
Asia	51	58	31	37	81	15	33	17	47	13	23	15	31	10
Southwest Pacific	80	33	56	63	100	100	96	100	58	86	69	61	81	50
Europe & the Caucasus	23	30	33	37	50	25	26	26	21	11	42	34	30	21
Latin America & the Caribbean	37	47	33	24	40	28	43	37	42	29	39	29	24	12
North America	100	100	100	100	n/a	100	n/a	100	n/a	100	100	100	0	100
Near & Middle East	33	57	0	50	50	33	21	21	18	14	n/a	0	0	0
World	42	47	42	45	64	25	33	30	34	21	41	33	30	23

Note: n/a indicates that no breed belonging to the respective species is reported from the respective region.

6. Breeding policies

A majority of countries report that they have national policies in place to support breeding progammes or influence their objectives (Figure 3B5). Dairy cattle breeding (75 percent of countries) is more frequently targeted than breeding in any other species or type of animal, . Chickens are the least targeted species among the big five (53 percent of countries). A number of countries in all regions except North America report the presence of breeding programmes but the absence of any policies in this field. A few countries, in contrast, report that they have no breeding programmes in place, but nonetheless have policies. Where most species are concerned, breeding policies are more prevalent in North America and Europe and the Caucasus than in other regions. Chicken breeding policies are, however, comparatively rare in Europe and the Caucasus (partly accounting for the low overall coverage of policies targeting this species). Asia has a high level of coverage in several species: 80 percent or higher in dairy and multipurpose cattle, goats, pigs and chickens. Latin America and the Caribbean has a similar high level of coverage in the case of dairy cattle.

The reported policies vary in terms of their objectives and in terms of the extent to which they are being successfully implemented. As noted above, a number of countries are seeking to promote greater use of exotic breeds and cross-breeding. If not well planned and implemented, policies of this type can contribute to the erosion of locally adapted breeds. The Global Plan of Action for Animal Genetic Resources subsumes breeding programmes within the broader field of sustainable use and development (Strategic Priority Area 2) and calls for "national sustainable use polices"[5] and "species and breed development strategies"[6] that should, *inter alia*, ensure that long-term objectives are adequately considered and that, where necessary, steps are taken to keep sufficiently diverse animal genetic resources in use. Implementation of these elements of the Global Plan of Action is moderately well advanced in terms of the number of countries having sustainable use policies in place (more than 50 percent of reporting countries) and considerable progress since the adoption of the Global Plan of Action in 2007 is reported. A majority of countries (close to 60 percent) also report that they have long-term sustainable use planning in place for at least some species and breeds. These figures, however, clearly also indicate large gaps in the coverage of sustainable use policies. National breeding policies are discussed in greater detail in the regional overviews presented below.

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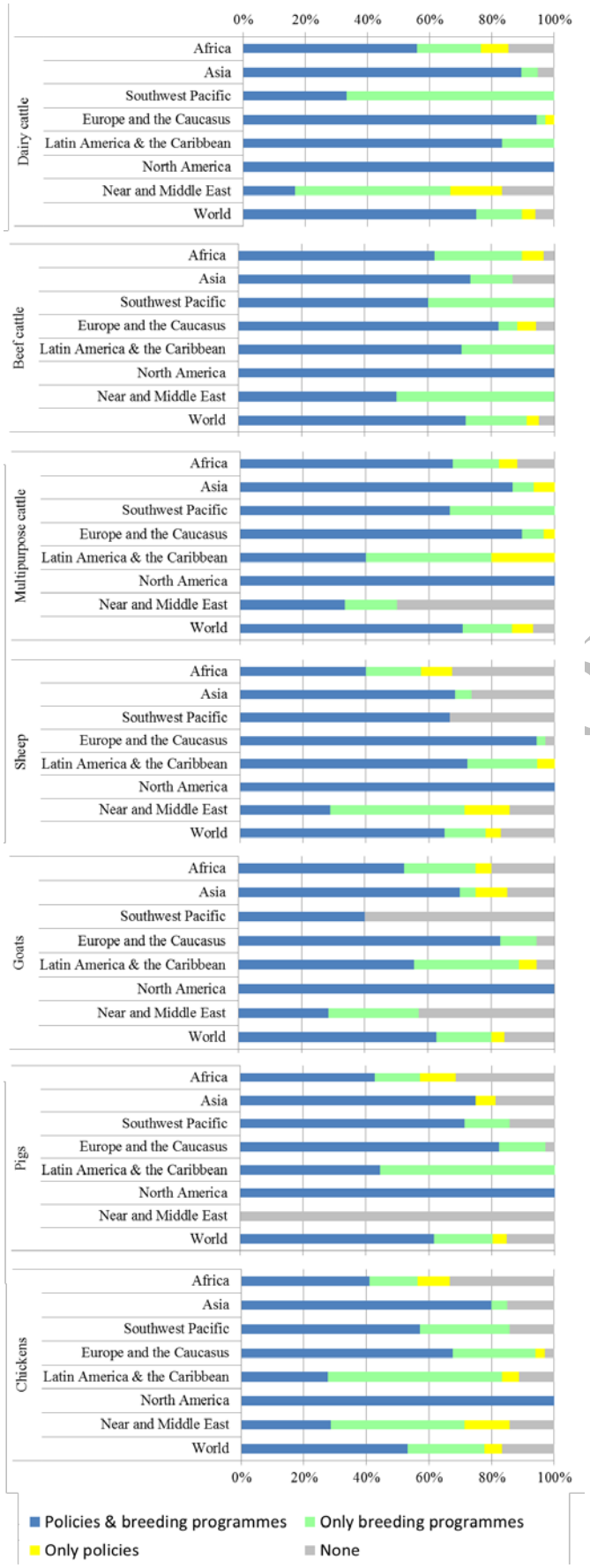
[5] Strategic Priority 3.
[6] Strategic Priority 4.

Figure 3B5. Proportion of countries reporting breeding programmes and policies (or programmes) supporting breeding programmes



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7. Regional overviews

As described above, the state of implementation of breeding programmes varies greatly from region to region. This subsection complements the statistics presented in the preceding subsections with region by region discussions of the characteristics, strengths and weaknesses of breeding programmes and policies. Unless otherwise stated, the material presented is based on the information provided in the country reports.

Breeding programmes in Africa are often based on governmental farms from which breeding animals and/or genetic material are distributed to livestock keepers. The main reported constraints to the development of more effective programmes in this region are a lack of funding, a lack of technical knowledge at all levels and a lack of organizational structures, particularly with respect to livestock-keeper participation in activities such as animal identification and performance recording.

The development of breeders' associations and their involvement in the operation of breeding programmes has generally been limited in Africa, although they play an increasing role in some countries (Box 3B1). In South Africa, for example, 72 breed societies "set standards and assist with evaluations" within the framework of the country's national animal recording and improvement schemes operated by its Agricultural Research Council's Animal Production Institute. In Namibia, breed societies "ensure that their breeders identify animals correctly, determine whether animal recording should be mandatory … and decide whether genetic evaluations should be undertaken." Nonetheless, the majority of the country's livestock keepers are reported not to be involved in any structured breeding programmes. In some countries, breeders' associations have been established, but their practical activities remain at a low level. In Rwanda, breeders' associations participate the country's "livestock working group" and their advice is taken into consideration in the setting of breeding goals. They also play a limited role in animal identification, performance recording and the provision of artificial insemination services in some species. Some countries report efforts to establish community-based breeding programmes. Where successful examples of programmes of this kind are reported, they are mainly operated by international research institutions or development NGOs. For example, in Ethiopia, the International Livestock Research Institute (ILRI) and the International Center for Agricultural Research in Dry Areas (ICARDA) have both established some community-based breeding programmes for small ruminants.

Cross-breeding of locally adapted breeds with high-output exotic breeds (often via the use of artificial insemination) is widely reported. The extent to which these efforts are organized or promoted by the government, and the extent to which steps are taken to minimize the risk of indiscriminate cross-breeding, varies from country to country. In Uganda, Boer goats (a breed originally imported from South Africa) are raised on government farms and bucks made available to farmers for cross-breeding with their indigenous animals. Goat keepers are trained in how to avoid indiscriminate crossbreeding and also in performance recording techniques.

Box 3B1. Sheep breeding in Tunisia

In Tunisia, the genetic improvement of sheep is monitored by the Farming and Pasture Office (OEP). Growth records are currently collected in only 109 flocks, via a simplified process involving four weighings. Registered breeds are the Barbarine tête Noire (9 flocks), Barbarine tête Rousse (58 flocks), Noire de Thibar (32 flocks), Queue Fine de l'Ouest (5 flocks) and the D'man (5 flocks). The number of registered flocks declined substantially after 2011: firstly, because of civil disturbances, which led to several farms being dissolved, and secondly, because of an attempt to reduce costs. The number of weighings was also reduced as a cost-saving measure. Registered flocks account for roughly 25 000 ewes, a small fraction of the national stock, which was estimated at 3 800 000 ewes in 2011 (Direction Générale de la Production Animale, 2011). Future breeding stocks are selected on conformation, health and daily-growth traits. Candidate rams and replacement ewes are then sold to breeders and institutional farms nationwide to spread genetic gain. Occasionally, the best rams are used for artificial insemination. On average, the genetic gains for growth traits have been roughly 10 percent of the mean. The Sicilo-Sarde dairy breed was recently added to the recording system (five

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flocks accounting for 100 ewes each). This breed's population size declined drastically to a few thousand ewes, but has increased to around 29 000 ewes in the last five years following an increase in the price of milk and the establishment of a breed association in the region of Béja in the north of Tunisia. The establishment of breed associations for other breeds is being encouraged, with the aim of supporting breeders, improving breed conservation and alleviating the financial burden on the state, which entirely finances existing improvement programmes. A further objective is to better involve researchers in the characterization and genetic evaluation of breeds and thereby provide a basis for the implementation of robust and durable improvement programmes appropriate for production systems in the various regions of the country.

Reference: Ministère de l'Agriculture, Direction Générale de la Production Animale. 2011. Enquête de structure. Tunis.
Provided by Boulbaba Rekik, National Coordinator for the Management of Animal Genetic Resources, Tunisia.

The design and implementation of breeding programmes in Asia is generally very dependent on the public sector, with research organizations often playing a significant role (Table 3B3). Nonetheless, approaches to the implementation of breeding programmes vary greatly across the region and there are many specificities at country and subregional levels.

In Central Asia, policies that foster cross-breeding with exotic breeds are widespread. In the Islamic Republic of Iran, for example, cross-breeding has been intensively used in dairy cattle, and to a lesser extent in sheep to improve meat production and in goats to improve milk production. The Iranian country report notes that breeding policies will in future continue to promote cross-breeding in dairy cattle, but that in beef cattle, sheep and goats the intention is to give greater attention to the genetic potential of locally adapted breeds. While in some countries livestock keepers are organized into breeders' associations and cooperatives that participate in the implementation of breeding programmes, this is not the case everywhere. The country report from Kazakhstan notes that the intention is to concentrate breeding activities on large collective farms. It also intends to establish a well-organized system for the use of imported genetic material.

In East Asia, breeding programmes are in place in the majority of countries for the main livestock species. Programmes are government driven, but livestock keepers are well organized in most countries (Table 3B3). Breeding programmes in Mongolia are less well developed than those in the other reporting countries in this subregion. The country reports two major constraints to the establishment of breeding programmes: the difficulty of organizing pedigree and performance recording in the country's extensive production systems, where livestock are unconfined and mating is usually uncontrolled; and livestock keepers' reluctance to participate in government-driven breeding programmes.

In South and Southeast Asia, governments are also generally quite active in the development of breeding policies and in the implementation of breeding programmes. However, the presence of large numbers of small-scale livestock keepers and a lack of breeders' associations lead to difficulties with the organizational aspects of breeding programmes. Breeding strategies in these subregions usually have a strong focus on cross-breeding with high-output exotic breeds. Governments often facilitate the distribution of breeding material from such breeds to livestock keepers. While breeding policies in several countries in these subregions have successfully contributed to increasing production levels, a lack of attention to locally adapted breeds has led to their genetic erosion via indiscriminate cross-breeding and breed replacement. In some countries, commercial companies are implementing breeding programmes, mainly in pigs and chickens. These programmes operate on a small scale, but their importance seems to be growing. The country report from Malaysia, for example, states that progress will depend on the private sector becoming the main driver of breeding programmes.

In New Zealand and Australia[7] breeding programmes are long-established and very well developed. Attention is focused largely on the development and improvement of a narrow range of species and breeds. Breeders' associations and livestock keepers' cooperatives play key roles. Breeding

[7] Australia did not submit a country report as part of the second SoW-AnGR process. However, it prepared a country report at its own initiative in 2012.

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programmes are organized by these bodies, and a large proportion of livestock keepers participate in them. Government and research institutions support some activities, but decision-making lies in the hands of the livestock keepers.

In the small island countries of the Southwest Pacific breeding programmes are rare and where they exist are in their early stages of development. It should be noted in this context that given the small size of these countries attempting to establish independent breeding programmes may anyway not be an appropriate strategy. Livestock-keeper organizations are not well developed and the few breeding programmes mentioned in the country reports are government driven. Private companies are sometimes involved, but there is little participation on the part of individual breeders. The most commonly reported activity is the importation and distribution of exotic breeds to replace local breeds or for cross-breeding with them. The country report from Samoa describes plans to involve large commercial farms as multipliers within a pyramidal breeding system as a means of meeting demand for breeding animals. The multipliers will be supplied with breeding animals from government-run nucleus farms, and in turn supply individual farmers.

In the majority of the countries of Europe and the Caucasus and North America (represented in the country reporting only by the United States of America), the livestock sector is well developed, and breeding programmes are long established and well organized (Table 3B4, 3B5 and Figure 3B5).

In the United States of America, breeding programmes are technologically advanced and widely implemented in all the main livestock species. Cross-breeding strategies are widespread (Table 3B7). Breeders associations and individual livestock keepers are the main stakeholders involved in the operation of breeding programmes (Table 3B3). National and international commercial companies have also a major role in cattle, pig and chicken breeding programmes. Advanced technologies such as genomic selection are widely used in dairy cattle breeding (see Annex A3B8). Decision-making regarding breeding activities rests with livestock keepers or commercial companies. Federal and state research organizations may develop means of evaluating traits that the industry deems important, but responsibility for adapting and utilizing such approaches lies with the industry.

In most European countries, breeders' associations are well organized and play a key role in the operation of breeding programmes (Table 3B3). In a number of countries (e.g. the Netherlands, Norway and the United Kingdom) the government's role in breeding programmes is largely restricted to providing support to breeders' associations via research activities. Generally, governments supervise and monitor the implementation and performance of breeding programmes. They implement animal identification schemes, in which all livestock keepers have to participate regardless of whether or not they are members of breeders' associations. They also support breeders' associations by coordinating their work. Some countries (e.g. France and Spain) provide subsidies to support the work of breeders' associations. Breeders' associations organize and implement performance and pedigree recording, set and review breeding goals, ensure the consistency of activities contributing to the genetic improvement of the breed and, where they have the capacity, implement genetic evaluations. Research institutes and universities support breeders' associations and governments in the theoretical and methodological aspects of genetic evaluation, as well as working on the development and refinement of breeding methods. There is, however, some variation across the region. In some countries, particularly in the Caucasus and parts of southeastern Europe, breeding programmes are relatively undeveloped. Livestock-keeper organization is limited and breeders' associations are rare.

In Europe and the Caucasus, commercial companies are active in dairy cattle and pig breeding and dominate the poultry-breeding sector. They control most of the market for genetic resources in these sectors and work with a narrow range of breeds and lines. As a result, their roles in breeding programmes for locally adapted breeds of pigs, chickens and dairy cattle are usually limited.

Many European countries rely, to varying degrees, on the use of imported genetics. A number of countries report that this poses a threat to the survival of some of their locally adapted breeds (see Part 1 Section [crossref]). However, in some countries it has proved possible to combine a programme of development based on the use of exotic breeds with measures that ensure that locally adapted breeds are maintained and that appropriate genetic material for use in more marginal production environments remains available (see, for example, Box 3B2).

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Box 3B2. Using exotic genetics in the dairy sector– experiences from Poland

Cattle breeding work undertaken in Poland after the Second World War focused on dual-purpose cattle. All breeds were used for both milk and meat production. The majority of cattle belonged to the Black and White and Red and White lowland breeds, with the Polish Red breed also making up a substantial proportion of the population. In this period only 20 percent of the cattle population was kept on, large-scale farms, while farms keeping one or two cows accounted for 40 percent (Trela and Choroszy, 2010).

The first national programme for the evaluation and selection of bulls for use in artificial insemination was introduced in 1971. Initially, the breeding value of the bulls was estimated using contemporary comparison. Best Linear Unbiased Prediction (BLUP) was introduced in 1985, and BLUP-Animal Model in 1991. The Programme on Genetic Improvement of Cattle Performance introduced in 1972, with a timeframe running till 1990, underlined the importance of artificial insemination, including the use of imported semen (which came mainly from the United States of America, Canada and Western Europe).

Before 1985, very little genetic progress was achieved within the national breeding scheme and therefore there was an urgent need for an alternative approach. The "Programme on Cattle Breeding and Production to 2000", adopted in 1986, for the first time accepted backcrossing with Holstein-Friesian bulls as a way of developing a specialized dairy population. This was to be complemented by ongoing improvement of pure-bred dual purpose cattle. Backcrossing with Holstein-Friesians presented an opportunity to benefit from the high genetic potential of this specialized dairy breed and to rapidly enhance the genetic value of the national cattle stock. Over time, the development of the herd book population became dependent on the import of Holstein-Friesian semen as the farmers' demand for high-performing dairy stock grew. However, the general use of Holstein-Friesian semen was not promoted, as a large part of the cattle population was kept in small herds (up to five cows) under modest husbandry conditions.

After the introduction of the market economy in 1990, the rapid development of the dairy processing sector facilitated the development of specialized dairy production and as a result backcrossing with Holstein-Friesian became widespread. The greater availability of imported semen contributed to this development. As a result of long-term continuous backcrossing, the active Black and White cattle population was completely replaced with the Holstein-Friesian genotype. This led to the recognition of a new breed, the Polish Holstein-Friesian, for which herd books were established in 2005 by the Polish Federation of Cattle Breeders and Dairy Farmers.

To maintain genetic resources of the traditional dual purpose types of Polish cattle, two remaining native breeds, the Polish Black and White and the Polish Red and White cattle, were included in the genetic resources conservation programme, as had been already been done for the Polish Red and Whitebacked breeds. This enabled the continued production of semen for use on farms where conditions are not suitable for the highly demanding Polish Holstein-Friesian cows.

The widespread use of Holstein-Friesian semen resulted in the transformation of the dual purpose population into a specialized dairy breed, and enabled the increase of national milk production while reducing the number of cows (5.5 million in 1985 and 2.4 million in 2013). In 2013, the average milk yield of the Polish Holstein-Friesian Black and White variety was 7 588 kg and that of the Red and White variety was 6 936 kg, while that of the Polish Black and White and the Polish Red and White breeds was 4 659 kg and 4 610 kg respectively (PFHBPM, 2013). It is clear that cross-breeding with an exotic highly specialized dairy breed has positively affected overall milk production. However, high performance was accompanied by decreased fertility, higher somatic cell counts, poor leg conformation and reduced herd-life (Pokorska *et al.*, 2012), problems that are common in the Holstein-Friesian population worldwide. To address these problems, the breeding goals within the programme were substantially widened in 2007. Moreover, in some commercial herds limited cross-breeding with Montbeliarde or Swedish /Norwegian Red cattle was initiated to improve health and robustness.

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Provided by Elżbieta Martyniuk, National Coordinator for the Management of Animal Genetic Resources, Poland.

In Latin America and the Caribbean, breeding programmes are diverse in terms of the stakeholder groups involved in organizing and implementing them. Depending on the country and the species, breeding programmes may be operated by the government, breeders' associations, commercial companies or livestock keepers organized at community level. However, some stakeholders are more important that others in terms of the implementation of specific breeding-programme elements. Governments are very active in the operation of animal identification schemes. Breeders' associations and individual livestock keepers are very much involved in the definition of breeding goals and in the recording of animal performance data. Artificial insemination is mainly delivered by commercial companies. Research institutions are heavily involved in genetic evaluations.

In the Caribbean, breeding programmes are less developed than in Central and South America. Governments are the main operators of the few breeding programmes that are in place. The importation of exotic genetic material for cross-breeding with locally breeds is a widely used strategy in this region. The best-developed breeding programmes are in the dairy cattle sector, which is characterized by a relatively high level of livestock keeper organization and the presence of commercial companies. In Suriname, for example, dairy cooperatives actively participate in the definition of breeding goals and also facilitate the provision of artificial services. In Trinidad and Tobago, a national commercial dairy company provides artificial insemination to some dairy farms, although on an irregular basis, and also records production data for some farms.

The majority of breeding programmes in Central and South America are implemented by breeders' associations or commercial companies. Breeders' associations generally receive support from the public sector, mainly via the work of research institutions, which are involved not only in genetic evaluation, but also on definition of breeding goals, in performance recording and in the organizational aspects of breeding programmes. Commercial companies, mainly national but in some cases international, are very active in the region and operate breeding programmes for dairy and beef cattle, pigs and chickens, and to a lesser extent goats. In Costa Rica, experiences gained in the implementation of cattle-breeding programmes are used to guide the development of programmes for small-ruminant species.

Cross-breeding strategies are reported to be quite widespread in Latin America (Table 3B7). Companies and research institutes have developed composite lines, mostly in beef cattle, but also in other species. Cross-breeding with exotic breeds (using both imported genetic material and genetic material sourced from within the region) and to a lesser extent with composite lines developed in the region, is widely used as a method of increasing production levels. Brazil reports a major increase in livestock productivity over recent years, brought about by the implementation of well-developed breeding programmes (Box 3B3). Research organizations at national and regional levels, as well as universities and breeders' associations, are responsible for the majority of Brazil's breeding programmes. In other countries (e.g. Chile, Ecuador and Paraguay) improvement of animal performance has been based on the importation of genetic material. Efforts to establish breeding programmes for each livestock species are currently ongoing. Peru and the Plurinational State of Bolivia have established breeding programmes aimed at improving fibre quality in llamas and alpacas. Bolivian programmes include some operated by community-owned companies, the main such company, COPROCA, involves 1 200 camelids keepers. Peru reports breeding programmes for several "minor" species, including rabbits, ducks and guinea pigs.

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Box 3B3. Beef cattle breeding in Brazil

As well as having the largest commercial cattle herd in the world, Brazil is currently the world's largest exporter of beef. In recent decades, breeding programmes have been at the forefront of beef-sector development and have achieved a marked increase in the productivity of beef breeds.

In 2003, when Brazil prepared its country report for the first SoW-AnGR, there were 16 breeding programmes operating in the beef sector, and they all remain operational.[8] Thirteen programmes target various Zebu breeds, with the objective of increasing reproductive efficiency and growth rate using classical breeding techniques allied with modern biotechnologies. Two other programmes are the Breeding Programme for Zebu Cattle (PMGZ) and GENEPLUS. The first of these is run by the Brazilian Zebu Breeders' Association, which identifies superior animals by calculating expected progeny differences (EPDs) for weight and weight gain at various ages, as well as for fertility traits and reproductive efficiency, based on a national database covering all Zebu breeds. GENEPLUS, provides zebu breeders with EPDs for various production and reproductive traits. The oldest Brazilian herd book, created in 1906, the Collares Herd Book, is responsible for the registration of British and continental cattle breeds, and operates PROMEBO, a genetic evaluation programme for seven *Bos taurus* breeds, which provides yearly sire summaries with EPDs for weights and reproductive traits.

One of the main successes had been a switch from selection for qualitative traits (e.g. ear size in Zebu cattle) to selection for quantitative traits with a more direct link to productivity. Since 2003, the number of animals recorded in the database of the PMGZ programme has risen from 1.5 million animals to 3.6 million animals, with 230 000 new animals entering the database each year. GENEPLUS today covers five Zebu breeds and four composite breeds, as well as two European breeds. Its database, which covered about 700 000 animals in 2003, now covers more than 2.5 million animals. Despite the successes, breeding programmes in Brazil still face many constraints. In the poorer regions of the country, the main constraints are:

a lack of farmer awareness and commitment to recording animal performance;

a low level of education among livestock keepers; and

the cost of recording for the smallholders, especially in the case of locally adapted breeds.

Future priority objectives for breeding programmes include, in addition to continuing to increase meat production, increasing dam longevity and meat quality. In Zebu cattle, meat tenderness is fundamental to maintaining export levels, especially exports to countries with higher quality requirements.

Provided by Arthur Mariante, National Coordinator for the Management of Animal Genetic Resources, Brazil.

The coverage and state of development of breeding programmes in the Near and Middle East are very limited. The programmes that do exist mainly involve sheep and goats and are based on governmental farms or breeding stations. The involvement of livestock keepers is very limited (Box 3B4). Selected animals, raised on governmental farms or imported, are distributed to livestock keepers with the aim of increasing production levels. Artificial insemination programmes operate on a limited scale.

Box 3B4. Sheep breeding in Jordan

Jordan's sheep breeding programmes are conducted on a very limited scale. Breeding stations distribute some selected rams to livestock keepers, without measuring the animals' productivity under field conditions and without monitoring. The majority of these rams are selected phenotypically, without genetic evaluation programmes.

A national animal identification and registration system is in place, but there is no performance and pedigree recording at the livestock keeper level. To establish a breeding programme at national level, animal identification needs to be linked to performance and pedigree information. Establishing such a programme would require well-qualified staff and good collaboration among stakeholders.

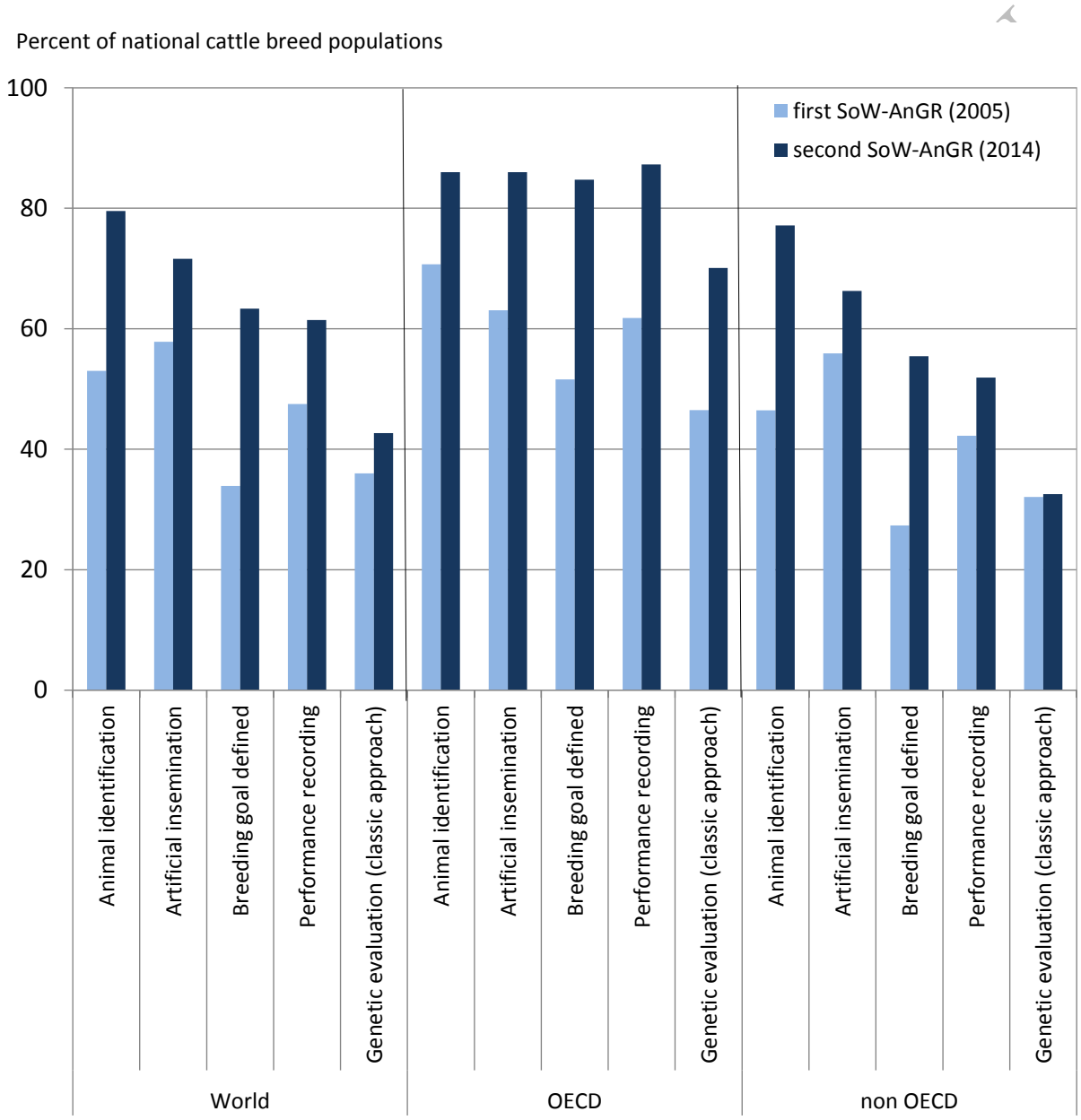
Source: Adapted from Jordan's country report.

[8] See Box 31 of the first SoW-AnGR (page 231).

8. Changes since 2005

As noted above, many of the data presented in this section are not directly comparable to those presented in the first SoW-AnGR because of the differences in the data-collection methods. However, in both reporting processes countries provided information on the number of breeds subject to various breeding-related activities. The list was slightly expanded for the second SoW-AnGR, but results for the activities covered in both processes are presented in Figure 3B6 (for cattle breeds).

Figure 3B6. Implementation of breeding tools in cattle: evolution between the first and the second SoW-AnGR



Note: The figure is based on information provided by the 35 countries (9 OECD and 26 non-OECD) that provided the relevant information in both SoW-AnGR reporting processes.

Because the first reporting process was not based on a structured questionnaire,[9] comparable figures are available for only 35 countries.[10] The results show that – at least as far as the 35 countries are concerned – the proportion of cattle breeds covered by all the various breeding-related activities has expanded since the time of the first SoW-AnGR reporting process. Is should, however, be noted that there are some differences between the pattern of developments in OECD countries and that in non-OECD countries. In particular, coverage of genetic evaluation has increased much more sharply in OECD countries (46 percent to 70 percent) than in non-OECD countries, where it has remained almost stable at around 32 percent. Given the progress made in the implementation of other breeding programme elements, addressing the coverage of genetic evaluations would appear to be the logical next step towards the more widespread establishment of effective breeding programmes.

9. Conclusions and priorities

While the majority of countries report that they have at least some breeding progammes in place, the reported levels of implementation of the various elements of breeding programmes suggest that these programmes are often in a very rudimentary state – or in some cases non-existent in the sense of organized progammes involving the establishment of breeding goals, recording of performance and subsequent selection of animals for mating.

The involvement of stakeholder groups in the organization and implementation of breeding programmes varies greatly from region to region. In Africa, Asia and the Near and Middle East, governments are the main players, while in North America, Europe and the Caucasus, Australia and New Zealand, responsibility for operating breeding programmes lies mainly in the hands of breeders' associations and commercial companies, with various degrees of support from governments and research organizations, depending on the country. The involvement of breeders' associations and commercial companies is also relatively well developed in parts of Latin America.

The first SoW-AnGR concluded that, where they existed, government-operated breeding programmes in developing countries tended to have limited impact because of a lack of interaction with livestock keepers. However, it also concluded that there were many constraints to the emergence of the "developed-country" model based on breeders' associations and involving minimal governmental support, particularly with regard to the organizational structures needed to facilitate the involvement of individual livestock keepers and the relatively high levels of knowledge and technical skills required. The information provided in the country reports suggests that many of these conditions have still not been met in many countries. While there are some reported examples of progress, livestock-keeper organization frequently remains poorly developed, as does education and training in the field of livestock breeding.

Many countries have put policies in place aimed at improving the state of livestock breeding. In many developing countries, in particular, these policies focus mainly on the introduction of exotic breeds for use in cross-breeding, sometimes with little attention to the establishment of breeding programmes. Utilizing the genetic progress already made in exotic breeds has obvious attractions for countries seeking to rapidly boost their output of livestock products. The difficulty lies in the fact that while increasing the availability of exotic genetic material may be relatively straightforward, ensuring that it is used appropriately is far more challenging.

While interest in expanding the use of exotic breeds is practically universal in developing countries, a number have also recognized the need to take greater advantage of the characteristics of their locally adapted breeds, particularly given the challenges associated with climate change and the ongoing need

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[9] During the first SoW-AnGR process, countries were provided with predefined tables or "tabulation tools", intended to facilitate the collection and analysis of information during the preparation of their country reports. Some countries included the completed tables in their country reports, while others did not.

[10] Albania, Argentina, Austria, Bangladesh, Benin, Brazil, Burundi, Cameroon, Croatia, Cyprus, the Democratic Republic of the Congo, Ethiopia, Gambia, Ghana, Greece, Guatemala, Iceland, Latvia, Lesotho, Madagascar, Malaysia, Mexico, Namibia, Norway, Paraguay, Republic of Korea, Senegal, Slovakia, Slovenia, Swaziland, Sweden, Togo, Ukraine, United Republic of Tanzania and Uruguay.

for livestock that are suitable for use by small-scale producers in low-input production systems. In this context, improving the productivity of locally adapted breeds through the implementation of breeding programmes is an appealing option, both because of the benefits derived directly from increasing livestock productivity and because it may help to keep the breeds in use and hence available as resources for the future. However, for the reasons noted above, implementing such programmes is very challenging. Only a small number of developing countries report the successful establishment of community-based breeding programmes in medium- or low-input production systems.

On the positive side, the evidence provided in the country reports suggests that the level of implementation of several of the main elements of breeding programmes – in terms of the number of breeds covered – has increased in recent years. Major gaps, nonetheless, remain in all developing regions. Animal identification appears to be the area where the most progress has been made, probably because of its multiple roles in livestock production.

As noted in the first SoW-AnGR, developing a national breeding strategy can be very challenging, particularly given that the information needed in order to assess the relative costs and benefits of different approaches is often unavailable. The existence of these knowledge gaps underlines the importance of strengthening efforts to characterize breeds and their production environments (see Section[crossref]) and Part 4 Section [crossref]) and the need to keep track of trends and drivers of change in the livestock sector (see Part 2).

Countries have a range of different short- and longer-term objectives and often have to deal with a diverse range of production systems. Specific priorities at national and production-system levels is therefore a matter for countries themselves to identify. The information provided in the country reports suggests that, at a more general level, priorities will often include capacity-building at all levels from livestock-keepers to policy-makers, as well as strengthening the organizational structures needed in order to implement successful breeding programmes. Livestock-keeper involvement is frequently a weak point in existing programmes.

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Annex 1. Stakeholders operating breeding programmes for the main livestock species

Table A3B1. Proportion of countries reporting different stakeholder groups as operators of dairy cattle breeding programmes

Dairy cattle	Number of countries	Government	Livestock keepers organized at community level	Breeder's associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**34**	68	24	35	18	0	26	6
East Africa	8	75	25	38	25	0	25	0
North & West Africa	14	57	21	36	7	0	21	0
Southern Africa	12	75	25	33	25	0	33	17
Asia	**19**	95	42	53	32	26	32	16
Central Asia	4	100	75	50	50	50	50	0
East Asia	4	100	25	50	25	50	25	0
South Asia	5	100	60	60	20	0	40	20
Southeast Asia	6	83	17	50	33	17	17	33
Southwest Pacific	**3**	67	33	67	67	100	33	0
Europe & the Caucasus	**35**	34	6	86	40	23	11	14
Latin America & the Caribbean	**18**	83	33	67	67	33	28	33
Caribbean	5	80	20	20	20	20	0	20
Central America	5	80	40	100	100	20	60	20
South America	8	88	38	75	75	50	25	50
North America	**1**	0	100	100	100	100	0	100
Near & Middle East	**6**	67	33	17	33	17	17	17
World	**116**	64	24	59	37	21	22	16

Note: Number of countries = the number reporting the presence of dairy cattle.

Table A3B2. Proportion of countries reporting different stakeholder groups as operators of beef cattle breeding programmes

Beef cattle	Number of countries	Government	Livestock keepers organized at community level	Breeder's associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**29**	62	31	38	34	10	7	3
East Africa	6	67	33	50	33	0	0	0
North & West Africa	12	67	25	42	25	25	17	0
Southern Africa	11	55	36	27	45	0	0	9
Asia	**15**	87	27	47	27	20	27	13
Central Asia	3	133	67	33	33	33	33	0
East Asia	4	75	25	50	25	25	25	0
South Asia	2	50	0	0	0	0	50	0
Southeast Asia	6	83	17	67	33	17	17	33
Southwest Pacific	**5**	60	20	40	40	60	40	0
Europe & the Caucasus	**34**	29	6	79	21	12	12	12
Latin America & the Caribbean	**17**	76	35	76	71	24	35	29
Caribbean	4	75	0	25	25	25	0	0
Central America	5	80	40	100	100	0	60	20
South America	8	75	50	88	75	38	38	50
North America	**1**	0	100	100	100	100	0	100
Near & Middle East	**2**	200	100	50	50	50	50	50
World	**103**	59	24	60	36	18	18	14

Note: Number of countries = the number reporting the presence of beef cattle.

Table A3B3. Proportion of countries reporting different stakeholder groups as operators of multipurpose cattle breeding programmes

Multipurpose cattle	Number of countries	Government	Livestock keepers organized at community level	Breeder's associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**34**	59	35	41	15	3	12	15
East Africa	7	71	29	43	29	0	0	14
North & West Africa	18	61	44	44	6	6	17	17
Southern Africa	9	44	22	33	22	0	11	11
Asia	**15**	93	53	40	20	27	40	13
Central Asia	4	100	75	50	25	50	50	0
East Asia	2	100	50	50	50	50	50	0
South Asia	5	100	60	20	0	0	40	20
Southeast Asia	4	75	25	50	25	25	25	25
Southwest Pacific	**3**	33	67	67	67	67	67	0
Europe & the Caucasus	**29**	48	7	79	28	10	17	14
Latin America & the Caribbean	**15**	67	20	47	40	13	20	27
Caribbean	4	75	25	0	0	25	0	0
Central America	5	60	20	60	60	0	40	20
South America	6	67	17	67	50	17	17	50
North America	**1**	0	100	100	0	0	0	100
Near & Middle East	**6**	67	50	17	17	17	17	17
World	**103**	61	30	52	24	13	20	17

Note: Number of countries = the number reporting the presence of multipurpose cattle.

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Table A3B4. Proportion of countries reporting different stakeholder groups as operators of sheep breeding programmes

Sheep	Number of countries	Government	Livestock keepers organized at community level	Breeder's associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**40**	45	33	33	8	3	15	10
East Africa	8	38	25	0	0	0	13	13
North & West Africa	20	45	30	40	10	5	20	10
Southern Africa	12	50	42	42	8	0	8	8
Asia	**19**	74	37	26	11	11	21	5
Central Asia	4	100	50	25	25	25	25	0
East Asia	4	50	25	25	25	25	25	0
South Asia	5	80	60	0	0	0	40	0
Southeast Asia	6	67	17	50	0	0	0	17
Southwest Pacific	**3**	33	33	67	67	67	67	0
Europe & the Caucasus	**35**	40	14	83	6	3	20	14
Latin America & the Caribbean	**18**	72	50	56	50	17	39	28
Caribbean	5	100	60	20	20	0	20	0
Central America	5	60	40	60	80	20	60	20
South America	8	63	50	75	50	25	38	50
North America	**1**	0	100	100	100	0	0	100
Near & Middle East	**7**	86	43	14	14	14	29	14
World	**123**	54	32	50	16	8	23	14

Note: Number of countries = the number reporting the presence of sheep.

Table A3B5. Proportion of countries reporting different stakeholder groups as operators of goat breeding programmes

Goats	Number of countries	Government	Livestock keepers organized at community level	Breeder's associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**40**	55	33	35	13	3	18	13
East Africa	8	75	25	38	0	0	38	13
North & West Africa	20	45	30	35	5	5	15	15
Southern Africa	12	58	42	33	33	0	8	8
Asia	**20**	75	30	35	25	15	20	10
Central Asia	4	100	50	25	50	25	25	0
East Asia	4	50	25	25	25	25	25	0
South Asia	6	67	33	17	17	0	33	0
Southeast Asia	6	83	17	67	17	17	0	33
Southwest Pacific	**5**	20	40	20	20	40	20	0
Europe & the Caucasus	**35**	40	20	77	3	0	20	14
Latin America & the Caribbean	**18**	61	44	50	44	17	33	22
Caribbean	5	100	60	20	20	0	0	0
Central America	5	60	20	60	80	20	60	20
South America	8	38	50	63	38	25	38	38
North America	**1**	0	100	100	100	0	0	100
Near & Middle East	**7**	71	43	14	14	14	29	14
World	**126**	54	32	48	17	8	21	14

Note: Number of countries = the number reporting the presence of goats.

Table A3B6. Proportion of countries reporting different stakeholder groups as operators of pig breeding programmes

Pigs	Number of countries	Government	Livestock keepers organized at community level	Breeder's associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**35**	40	23	23	14	6	14	6
East Africa	6	33	17	0	17	0	0	0
North & West Africa	18	39	22	33	6	11	22	6
Southern Africa	11	45	27	18	27	0	9	9
Asia	**16**	75	38	50	44	31	25	13
Central Asia	2	50	50	50	50	50	50	0
East Asia	4	75	25	50	50	50	25	0
South Asia	4	100	50	50	25	0	25	0
Southeast Asia	6	67	33	50	50	33	17	33
Southwest Pacific	**7**	57	43	29	29	43	29	29
Europe & the Caucasus	**34**	35	3	76	47	38	18	15
Latin America & the Caribbean	**18**	39	33	61	61	39	28	17
Caribbean	5	60	40	20	40	0	0	0
Central America	5	40	20	100	80	40	60	20
South America	8	25	38	63	63	63	25	25
North America	**1**	0	0	100	100	100	0	100
Near & Middle East	**1**	0	0	0	0	0	0	0
World	**112**	44	21	50	38	28	20	13

Note: Number of countries = the number reporting the presence of pigs.

Table A3B7. Proportion of countries reporting different stakeholder groups as operators of chicken breeding programmes

Chickens	Number of countries	Government	Livestock keepers organized at community level	Breeder's associations or cooperatives	National commercial companies	External commercial companies	NGOs	Others
		%						
Africa	**39**	38	23	21	18	18	15	10
East Africa	8	50	13	13	0	25	13	13
North & West Africa	19	26	21	26	16	11	21	11
Southern Africa	12	50	33	17	33	25	8	8
Asia	**20**	80	40	50	55	25	30	10
Central Asia	4	75	50	50	50	25	50	0
East Asia	4	75	25	50	50	50	25	0
South Asia	6	83	50	33	50	0	33	0
Southeast Asia	6	83	33	67	67	33	17	33
Southwest Pacific	**7**	57	43	29	29	43	43	14
Europe & the Caucasus	**34**	32	9	53	32	53	21	12
Latin America & the Caribbean	**18**	22	17	44	56	39	22	17
Caribbean	5	0	0	0	40	20	0	0
Central America	5	40	20	40	60	20	40	20
South America	8	25	25	75	63	63	25	25
North America	**1**	0	0	100	100	100	0	100
Near & Middle East	**7**	57	29	29	43	29	29	14
World	**126**	43	22	39	36	34	22	13

Note: Number of countries = the number reporting the presence of chickens.

Annex 2. Presence of the elements of breeding programmes – ”big five” species

Table A3B8. Proportion of countries reporting organized breeding activities for locally adapted and exotic breeds of dairy cattle

Regions and subregions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**106**	**43**	58	56	29	35	26	26	75	63
East Africa	25	9	72	11	24	0	40	0	96	22
North & West Africa	44	23	41	61	27	35	16	30	43	61
Southern Africa	37	11	68	82	35	64	30	36	100	100
Asia	**37**	**31**	73	58	59	45	65	45	73	52
Central Asia	4	12	100	83	75	67	75	67	75	67
East Asia	9	1	33	100	78	100	33	100	78	100
South Asia	15	6	93	33	67	0	93	0	93	33
Southeast Asia	9	12	67	42	22	42	44	42	33	42
Southwest Pacific	**10**	**3**	90	67	70	67	70	67	70	0
Europe & the Caucasus	**114**	**92**	94	95	91	91	89	87	100	87
Latin America & the Caribbean	**65**	**38**	43	97	34	68	28	61	51	71
Caribbean	11	6	9	67	0	17	0	17	18	67
Central America	16	21	63	95	13	90	6	62	69	76
South America	38	11	45	100	53	55	45	82	53	64
North America	**4**	**11**	100	100	100	100	100	100	100	100
Near & Middle East	**12**	**7**	42	43	42	29	42	29	42	43
World	**348**	**225**	69	81	56	68	54	64	81	73

Regions and subregions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**106**	**43**	39	49	17	33	7	0	20	12
East Africa	25	9	44	11	24	0	0	0	36	0
North & West Africa	44	23	39	52	11	30	0	0	2	9
Southern Africa	37	11	35	73	19	64	19	0	30	27
Asia	**37**	**31**	54	39	32	42	14	6	16	16
Central Asia	4	12	75	50	75	58	0	8	25	33
East Asia	9	1	33	100	22	100	11	100	33	100
South Asia	15	6	67	0	33	0	13	0	0	0
Southeast Asia	9	12	44	42	22	42	22	0	22	0
Southwest Pacific	**10**	**3**	70	67	70	67	70	67	70	67
Europe & the Caucasus	**114**	**92**	55	86	44	65	19	41	48	71
Latin America & the Caribbean	**65**	**38**	23	55	14	50	5	11	8	18
Caribbean	11	6	18	17	0	17	0	0	0	17
Central America	16	21	6	67	6	57	0	0	0	5
South America	38	11	32	55	21	55	8	36	13	45
North America	**4**	**11**	100	100	100	100	100	100	100	100
Near & Middle East	**12**	**7**	42	29	17	29	8	29	17	0
World	**348**	**225**	45	66	29	54	14	26	29	42

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

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Table A3B9. Proportion of countries reporting organized breeding activities for locally adapted and exotic breeds of beef cattle

Regions and subregions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**99**	**109**	79	63	62	59	37	43	67	31
East Africa	14	5	71	20	43	20	0	40	43	60
North & West Africa	28	51	79	33	71	29	7	6	68	31
Southern Africa	57	53	81	96	61	91	61	79	72	28
Asia	**48**	**71**	48	66	25	52	33	54	52	56
Central Asia	7	10	100	100	100	90	100	90	100	60
East Asia	16	11	0	64	13	73	13	73	31	64
South Asia	1	1	100	0	0	0	100	0	100	0
Southeast Asia	24	49	63	61	13	41	25	43	50	55
Southwest Pacific	**25**	**8**	56	63	52	63	8	100	48	50
Europe & the Caucasus	**239**	**186**	92	95	82	95	80	86	76	68
Latin America & the Caribbean	**138**	**109**	62	76	51	68	43	46	54	47
Caribbean	10	5	10	60	0	60	0	60	10	20
Central America	14	60	29	90	29	92	29	55	43	57
South America	114	44	71	59	59	36	49	32	60	36
North America	**4**	**55**	0	100	0	100	0	60	0	100
Near & Middle East	**5**	**2**	20	50	0	50	0	50	0	100
World	**558**	**540**	76	81	63	76	55	64	65	59

Regions and subregions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**99**	**109**	59	63	26	41	21	10	24	24
East Africa	14	5	14	20	0	0	0	0	0	0
North & West Africa	28	51	75	35	7	4	0	2	0	2
Southern Africa	57	53	61	94	42	81	37	19	42	47
Asia	**48**	**71**	29	41	19	44	0	23	0	20
Central Asia	7	10	100	90	100	60	0	30	0	40
East Asia	16	11	0	36	13	27	0	27	0	45
South Asia	1	1	100	0	0	0	0	0	0	0
Southeast Asia	24	49	25	33	0	45	0	20	0	10
Southwest Pacific	**25**	**8**	56	63	52	63	52	63	52	63
Europe & the Caucasus	**239**	**186**	77	80	55	67	14	20	38	69
Latin America & the Caribbean	**138**	**109**	25	44	8	37	5	6	9	14
Caribbean	10	5	10	60	0	60	0	0	0	60
Central America	14	60	0	55	0	40	0	0	0	2
South America	114	44	29	27	10	30	6	16	11	25
North America	**4**	**55**	n/a	96	n/a	53	n/a	29	n/a	35
Near & Middle East	**5**	**2**	0	50	0	0	0	50	0	0
World	**558**	**540**	54	66	34	51	13	17	25	38

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

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Table A3B10. Proportion of countries reporting organized breeding activities for locally adapted and exotic breeds of multipurpose cattle

Regions and subregions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**46**	**130**	93	32	65	15	24	19	100	35
East Africa	13	60	62	15	38	10	15	10	92	28
North & West Africa	14	52	100	40	100	15	21	25	100	33
Southern Africa	19	18	68	61	32	28	32	33	68	61
Asia	**21**	**121**	67	22	19	11	57	21	57	31
Central Asia	4	6	50	83	50	83	50	83	50	83
East Asia	4	56	50	4	50	0	50	0	50	2
South Asia	8	47	63	30	0	13	38	30	63	64
Southeast Asia	5	12	100	50	0	17	100	50	60	17
Southwest Pacific	**9**	**2**	78	100	78	100	78	100	78	0
Europe & the Caucasus	**60**	**159**	98	88	93	81	73	75	75	74
Latin America & the Caribbean	**25**	**40**	56	45	24	25	12	25	24	33
Caribbean	6	8	50	50	0	0	0	0	0	25
Central America	5	21	60	38	40	38	20	29	60	38
South America	14	11	57	55	29	18	14	36	21	27
North America	**0**	**4**	n/a	0	n/a	0	n/a	0	n/a	0
Near & Middle East	**4**	**15**	25	20	25	0	25	0	50	40
World	**165**	**471**	84	49	63	37	47	38	78	47

Regions and subregions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**46**	**130**	67	25	15	14	13	1	26	8
East Africa	13	60	15	15	0	10	0	0	38	10
North & West Africa	14	52	100	31	7	19	0	0	0	6
Southern Africa	19	18	42	44	32	11	32	6	37	11
Asia	**21**	**121**	67	20	10	12	0	1	10	7
Central Asia	4	6	50	83	50	67	0	17	0	50
East Asia	4	56	50	0	0	0	0	0	50	0
South Asia	8	47	63	30	0	17	0	0	0	11
Southeast Asia	5	12	100	42	0	17	0	0	0	0
Southwest Pacific	**9**	**2**	78	100	78	100	78	100	78	100
Europe & the Caucasus	**60**	**159**	72	66	65	56	43	16	55	67
Latin America & the Caribbean	**25**	**40**	16	23	0	18	0	5	0	5
Caribbean	6	8	0	0	0	0	0	0	0	0
Central America	5	21	0	29	0	24	0	0	0	0
South America	14	11	29	27	0	18	0	18	0	18
North America	**0**	**4**	n/a	0	n/a	0	n/a	0	n/a	0
Near & Middle East	**4**	**15**	25	13	25	7	0	0	25	0
World	**165**	**471**	61	37	34	28	24	7	33	27

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

Table A3B11. Proportion of countries reporting organized breeding activities for locally adapted and exotic breeds of sheep

Regions and subregions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**59**	**119**	46	41	34	26	25	29	17	18
East Africa	19	25	47	16	16	12	16	12	0	0
North & West Africa	17	56	29	30	35	13	6	23	6	4
Southern Africa	23	38	57	74	48	55	48	50	39	50
Asia	**43**	**181**	35	41	23	35	21	42	21	30
Central Asia	5	55	80	89	80	89	80	89	80	89
East Asia	11	64	0	0	9	0	0	0	9	0
South Asia	11	49	55	37	0	22	9	37	0	0
Southeast Asia	16	13	31	54	31	31	25	69	25	46
Southwest Pacific	**26**	**14**	69	93	69	93	69	93	69	93
Europe & the Caucasus	**341**	**616**	97	90	82	84	60	76	23	19
Latin America & the Caribbean	**122**	**67**	52	55	50	48	35	33	43	25
Caribbean	15	9	33	67	0	0	0	0	20	44
Central America	22	20	27	70	36	60	14	55	41	30
South America	85	38	61	45	62	53	47	29	47	18
North America	**0**	**57**	n/a	91	n/a	72	n/a	61	n/a	49
Near & Middle East	**14**	**24**	29	17	21	8	29	8	29	4
World	**605**	**1078**	76	73	65	65	49	60	28	24

Regions and subregions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**59**	**119**	39	36	19	23	15	13	20	18
East Africa	19	25	26	16	11	12	0	0	16	0
North & West Africa	17	56	35	21	0	11	0	0	0	4
Southern Africa	23	38	52	71	39	47	39	42	39	53
Asia	**43**	**181**	37	35	9	33	0	1	5	24
Central Asia	5	55	80	64	80	80	0	0	20	51
East Asia	11	64	9	0	0	0	0	0	9	0
South Asia	11	49	55	39	0	24	0	2	0	24
Southeast Asia	16	13	31	77	0	31	0	8	0	31
Southwest Pacific	**26**	**14**	69	93	69	93	69	93	12	93
Europe & the Caucasus	**341**	**616**	77	73	42	49	1	1	45	52
Latin America & the Caribbean	**122**	**67**	36	31	32	33	8	4	10	10
Caribbean	15	9	53	0	0	0	0	0	0	0
Central America	22	20	14	55	5	45	0	0	0	0
South America	85	38	39	26	45	34	12	8	14	18
North America	**0**	**57**	n/a	91	n/a	23	n/a	0	n/a	32
Near & Middle East	**14**	**24**	29	13	29	8	0	8	29	8
World	**605**	**1078**	60	60	36	41	7	4	31	39

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

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Table A3B12. Proportion of countries reporting organized breeding activities for locally adapted and exotic breeds of goats

Regions and subregions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**77**	**93**	39	45	25	22	25	26	13	8
East Africa	21	24	48	33	19	17	24	21	5	0
North & West Africa	23	42	35	43	26	19	17	26	13	5
Southern Africa	33	27	36	59	27	30	30	30	18	19
Asia	**45**	**144**	47	32	20	23	36	29	33	13
Central Asia	5	16	60	81	60	56	60	56	60	44
East Asia	5	73	0	4	0	5	0	4	0	1
South Asia	15	34	60	56	7	38	27	56	40	12
Southeast Asia	20	21	45	52	25	33	45	52	30	29
Southwest Pacific	**12**	**7**	58	71	50	71	58	14	50	57
Europe & the Caucasus	**138**	**189**	90	94	69	81	64	69	30	14
Latin America & the Caribbean	**59**	**58**	44	55	47	34	29	22	32	38
Caribbean	10	12	50	58	0	0	0	17	50	50
Central America	12	23	0	65	8	52	8	26	42	39
South America	37	23	57	43	73	35	43	22	24	30
North America	**0**	**16**	n/a	100	n/a	69	n/a	75	n/a	100
Near & Middle East	**11**	**21**	18	33	27	5	27	5	18	5
World	**342**	**528**	61	62	47	46	44	42	27	19

Regions and subregions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**77**	**93**	26	35	16	23	12	6	18	11
East Africa	21	24	24	25	14	17	0	0	19	4
North & West Africa	23	42	30	31	13	26	13	7	0	5
Southern Africa	33	27	24	52	18	22	18	11	30	26
Asia	**45**	**144**	49	28	16	17	7	1	11	14
Central Asia	5	16	60	56	60	44	0	0	40	25
East Asia	5	73	0	1	0	0	0	0	0	1
South Asia	15	34	67	59	7	41	0	0	0	38
Southeast Asia	20	21	45	52	15	19	15	10	15	10
Southwest Pacific	**12**	**7**	58	71	50	57	50	57	58	71
Europe & the Caucasus	**138**	**189**	69	61	39	38	4	2	40	58
Latin America & the Caribbean	**59**	**58**	34	28	14	14	5	0	7	12
Caribbean	10	12	50	0	0	0	0	0	0	17
Central America	12	23	8	52	0	13	0	0	0	0
South America	37	23	38	17	22	22	8	0	11	22
North America	**0**	**16**	n/a	88	n/a	31	n/a	0	n/a	50
Near & Middle East	**11**	**21**	27	29	9	29	0	24	9	24
World	**342**	**528**	49	44	26	27	8	4	25	31

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

Table A3B13. Proportion of countries reporting organized breeding activities for locally adapted and exotic breeds of pigs

Regions and subregions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**91**	**52**	40	25	25	12	26	10	27	2
East Africa	14	6	57	17	21	0	21	0	29	0
North & West Africa	41	28	29	43	17	21	12	18	7	4
Southern Africa	36	18	44	0	36	0	44	0	50	0
Asia	**61**	**133**	30	21	41	13	34	22	44	13
Central Asia	2	7	100	71	100	71	100	71	100	71
East Asia	29	85	0	4	55	4	21	4	24	5
South Asia	16	9	25	33	0	0	6	44	38	0
Southeast Asia	14	32	86	53	50	28	86	53	86	25
Southwest Pacific	**26**	**18**	50	67	42	33	50	28	38	17
Europe & the Caucasus	**142**	**192**	87	85	86	85	75	77	74	55
Latin America & the Caribbean	**80**	**70**	24	50	24	23	25	30	40	31
Caribbean	14	12	29	67	0	0	0	25	29	33
Central America	14	22	0	77	0	59	0	64	57	82
South America	52	36	29	28	37	8	38	11	38	0
North America	**1**	**25**	100	88	100	60	100	80	100	56
Near & Middle East	**0**	**1**	n/a	0	n/a	0	n/a	0	n/a	0
World	**401**	**491**	53	56	50	45	47	46	50	33

Regions and subregions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**91**	**52**	34	17	12	6	11	0	15	2
East Africa	14	6	36	0	0	0	0	0	21	0
North & West Africa	41	28	24	32	2	11	0	0	2	4
Southern Africa	36	18	44	0	28	0	28	0	28	0
Asia	**61**	**133**	43	17	25	14	18	8	25	4
Central Asia	2	7	100	71	100	71	0	0	0	0
East Asia	29	85	28	2	14	4	7	1	28	1
South Asia	16	9	25	33	0	0	0	0	0	0
Southeast Asia	14	32	86	38	64	34	64	28	50	13
Southwest Pacific	**26**	**18**	58	67	38	28	38	28	42	39
Europe & the Caucasus	**142**	**192**	70	73	59	63	6	20	39	56
Latin America & the Caribbean	**80**	**70**	36	24	15	24	4	4	4	4
Caribbean	14	12	29	25	0	0	0	0	0	0
Central America	14	22	0	45	0	59	0	0	0	0
South America	52	36	48	11	23	11	6	8	6	8
North America	**1**	**25**	100	80	100	40	100	24	100	64
Near & Middle East	**0**	**1**	n/a	0	n/a	0	n/a	0	n/a	0
World	**401**	**491**	51	45	33	36	11	13	25	29

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

Table A3B14. Proportion of countries reporting organized breeding activities for locally adapted and exotic breeds of chickens

Regions and subregions	Number of national breed populations		Animal identification		Pedigree recording		Performance recording		Artificial insemination	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**193**	**100**	23	17	10	10	7	6	5	5
East Africa	33	21	12	24	0	5	0	5	0	5
North & West Africa	103	41	29	27	19	15	13	5	0	0
Southern Africa	57	38	18	3	0	8	0	8	18	11
Asia	**119**	**268**	50	16	29	10	45	16	28	8
Central Asia	18	14	100	79	100	57	100	57	100	43
East Asia	28	156	0	0	14	3	0	0	0	6
South Asia	33	31	55	35	21	10	39	35	36	10
Southeast Asia	40	67	58	33	10	15	53	37	5	6
Southwest Pacific	**42**	**14**	5	43	0	29	10	43	0	0
Europe & the Caucasus	**1017**	**605**	23	65	10	61	11	60	11	18
Latin America & the Caribbean	**201**	**92**	9	14	20	1	24	15	0	12
Caribbean	13	11	0	18	0	0	0	45	0	0
Central America	22	52	9	17	0	2	9	17	0	21
South America	166	29	10	7	25	0	28	0	0	0
North America	**10**	**54**	0	43	0	11	0	15	0	7
Near & Middle East	**23**	**29**	35	14	17	14	26	14	4	0
World	**1605**	**1162**	23	43	12	36	14	39	10	13

Regions and subregions	Number of national breed populations		Breeding goal defined		Genetic evaluation (classic approach)		Genetic evaluation including genomic information		Management of genetic variation	
	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted	Exotic	Locally adapted
			(%)							
Africa	**193**	**100**	11	14	7	6	0	4	7	3
East Africa	33	21	0	5	0	5	0	0	0	0
North & West Africa	103	41	19	20	13	5	0	2	13	0
Southern Africa	57	38	4	13	0	8	0	8	0	8
Asia	**119**	**268**	54	17	24	9	3	4	15	4
Central Asia	18	14	100	57	100	43	0	0	39	43
East Asia	28	156	14	1	0	0	0	0	0	0
South Asia	33	31	55	35	21	13	0	0	0	0
Southeast Asia	40	67	58	37	8	22	10	18	28	9
Southwest Pacific	**42**	**14**	10	57	71	29	71	29	76	29
Europe & the Caucasus	**1017**	**605**	37	72	9	38	1	3	9	41
Latin America & the Caribbean	**201**	**92**	23	16	1	16	0	0	0	0
Caribbean	13	11	0	0	0	0	0	0	0	0
Central America	22	52	0	27	0	27	0	0	0	0
South America	166	29	28	3	1	3	0	0	0	0
North America	**10**	**54**	0	100	0	11	0	11	0	50
Near & Middle East	**23**	**29**	35	3	22	14	0	3	0	0
World	**1605**	**1162**	33	50	10	25	3	4	9	26

Notes: The figures indicate the presence of the respective breeding-programme elements and techniques, but provide no indication of population coverage within breeds.

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SECTION C. CONSERVATION PROGRAMMES

1. Introduction

This section presents a review of the state of conservation programmes based on information provided in the country reports. Conservation actions are commonly grouped into three categories: *in situ* conservation, *ex situ in vivo* conservation and *ex situ in vitro* conservation (see Part 4 Section [crossref] for a discussion of the state of the art in conservation methods). These categories were defined in the country-report questionnaire as follows:

- *In situ* conservation: support for continued use by livestock keepers in the production system in which the livestock evolved or are now normally found and breed.
- *Ex situ in vivo* conservation: maintenance of live animal populations not kept under their normal management conditions – e.g. in zoological parks or governmental farms – and/or outside the area in which they evolved or are now normally found.
- *Ex situ in vitro* conservation: conservation, under cryogenic conditions including, *inter alia*, the cryoconservation of embryos, semen, oocytes, somatic cells or tissues having the potential to reconstitute live animals in a later date.

The section is structured as follows: Subsection 2 presents an overview of the state of conservation programmes worldwide. In subsection 3, *in situ* conservation programmes are discussed in more detail, including an analysis of the types of activities undertaken and whether they are managed by the public or private sectors. In subsection 4, *ex situ in vitro* conservation programmes are discussed in greater depth, including an analysis of the types of material stored and the breed coverage. Subsection 5 presents a region by region overview of the state of conservation programmes. Subsection 6 presents an analysis of changes in the state of conservation programmes since the time the first report on *The State of the World's Animal Genetic Resources for Food and Agriculture* (first SoWAnGR) (FAO, 2007a). The final subsection presents some conclusions and discusses priority actions that need to be taken in order improve of the state AnGR conservation programmes worldwide.

2. Overview of the status of conservation programmes

The country-report questionnaire requested countries to provide scores (none, low, medium or high) for the extent to which their breed populations are covered by each of the three categories of conservation programmes. Given that some breeds may be in so secure state that they do not need to be included in a conservation programme, countries were asked to focus particularly on at-risk breeds. The main objective, as stated in the questionnaire, was to obtain an indication of the extent to which the countries' programmes meet the objective of minimizing the risk of breed extinction. Countries where all breeds are regarded as secure had the option of indicating this as an explanation for the absence of programmes in a given category.

The majority (82 percent) of country reports indicate the presence of *in situ* conservation programmes for breeds belonging to at least one species. However, there is a lot of variation across the regions and subregions of the world (Table 3C1). *In situ* conservation programmes are reported by all countries in Europe and the Caucasus, Central Asia, East Asia and North America (represented in the country reporting only by the United States of America). North and West Africa (65 percent) and Central America (60 percent) are the subregions in which the lowest proportions of countries report the presence of *in situ* conservation programmes. It should be noted that these figures simply indicate the presence of conservation programmes. They provide no indication of how many breeds are targeted or how effective the programmes are.

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Table 3C1. Proportion of countries reporting conservation activities for at least one species

Regions and Subregions	Number of countries	In situ conservation	Ex situ in vivo conservation	Ex situ in vitro conservation
		%		
Africa	**40**	70	48	30
East Africa	8	75	63	50
North & West Africa	20	65	40	20
Southern Africa	12	75	50	33
Asia	**20**	90	80	65
Central Asia	4	100	50	50
East Asia	4	100	100	100
South Asia	6	83	83	33
Southeast Asia	6	83	83	83
Southwest Pacific	**7**	71	29	14
Europe & the Caucasus	**35**	100	69	86
Latin America & the Caribbean	**18**	83	72	61
Caribbean	5	100	80	60
Central America	5	60	40	60
South America	8	88	88	63
North America	**1**	100	100	100
Near & Middle East	**7**	86	71	29
World	**128**	82	60	54

Ex situ conservation programmes are less common than *in situ* programmes: 60 percent and 54 percent of countries reported *ex situ in vivo* and *ex situ in vitro* programmes, respectively. The figures are particularly low in the Southwest Pacific (29 percent and 14 percent), while 100 percent of East Asian countries reported the presence of both types of programme.

While the overall figures indicate that conservation programmes are widespread, the country-report responses regarding the level of breed coverage (see above) indicate that in many countries programmes are far from being comprehensive. This is illustrated, for example, by Figure 3C1, which shows average national bred coverage scores for *in situ* programmes at country (taking into account the so-called "big five" species – cattle, chickens, pigs, sheep and goats). A more detailed breakdown, covering all three categories of conservation programme, is presented in Figure 3C2. High scores for breed coverage (i.e. comprehensive conservation programmes for a given species at national level) are rare globally: 23 percent in the case of *in situ* programmes; 7 percent in the case of *ex situ in vivo* programmes; and 8 percent in the case of *ex situ in vitro* programmes.[1] The regional breakdown shows that the main exceptions are the coverage of *in situ* and *ex situ in vitro* programmes in North America and to a lesser extent in Europe and the Caucasus. The breed coverage of e*x situ in vivo* programmes is generally low even in developed regions, where this type of programme appears to be a low priority relative to the other two categories. In all categories, high scores are more common in Latin America and the Caribbean than in any other developing region.

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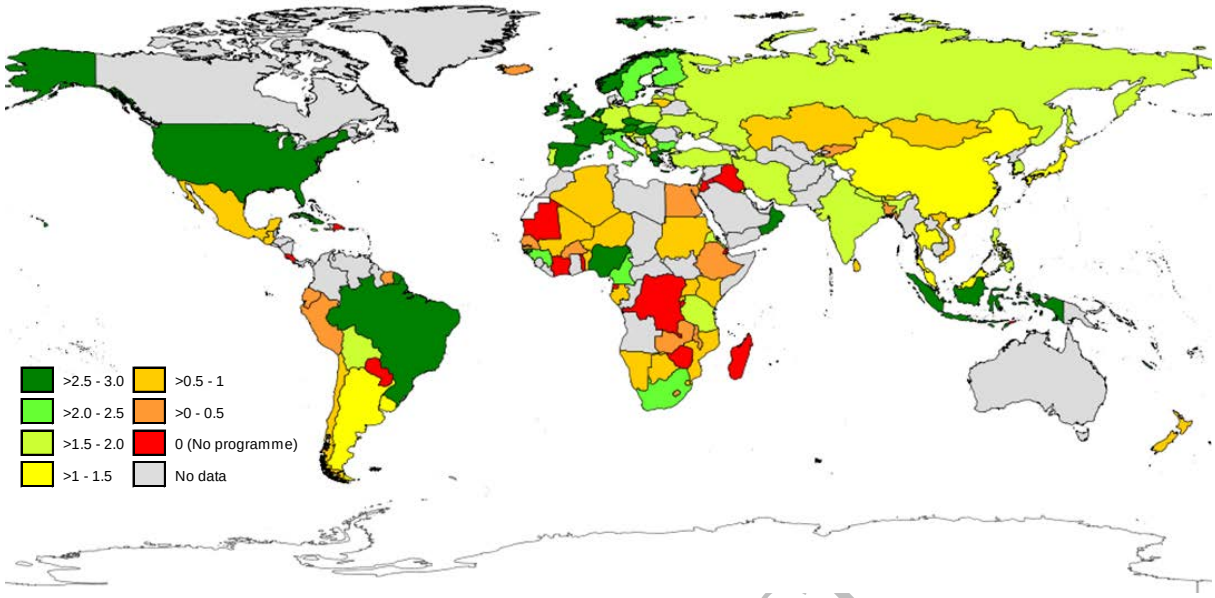
[1] Cases where the species is absent or all breeds are considered secure are excluded from these calculations.

Figure 3C1. Average reported coverage of *in situ* conservation programmes for the "big five" livestock species



Notes: Coverage indicates the reported extent to which country's breeds are covered by conservation programmes. Coverage was scored none (0), low (1), medium (2) or high (3) for each of the big five species (cattle, sheep, pigs, chickens and goats), with beef, dairy and multipurpose cattle treated separately, i.e. a total of seven categories. Countries could specify that no programmes are implemented in a given category because all breeds are secure. The average scores are calculated based on the scores for all the species/categories reported to be present in the country, with the exception of those in which all breeds are reported to be secure. Sierra Leone is shown on the map as having no data (grey) because in all the species/categories reported present, the option "no programmes implemented because all breeds are secure" was chosen.

Table 3C2 shows that, while in some regions breed coverage within a given category of programme is at a similar level across all species, in others some species are more comprehensively covered than others. For example, in the case of *in situ* programmes, sheep, pigs and multipurpose cattle have the highest average scores in Europe and the Caucasus, dairy cattle in Latin America and the Caribbean, chickens in Asia and small ruminants in the Near and Middle East. In the case of *ex situ in vitro* programmes, the global totals indicate a higher level of coverage for cattle and sheep than for other species, although there are again some regional variations. Subregional breakdowns showing the three categories of conservation programme are presented in Tables 3C3, 3C4 and 3C5.

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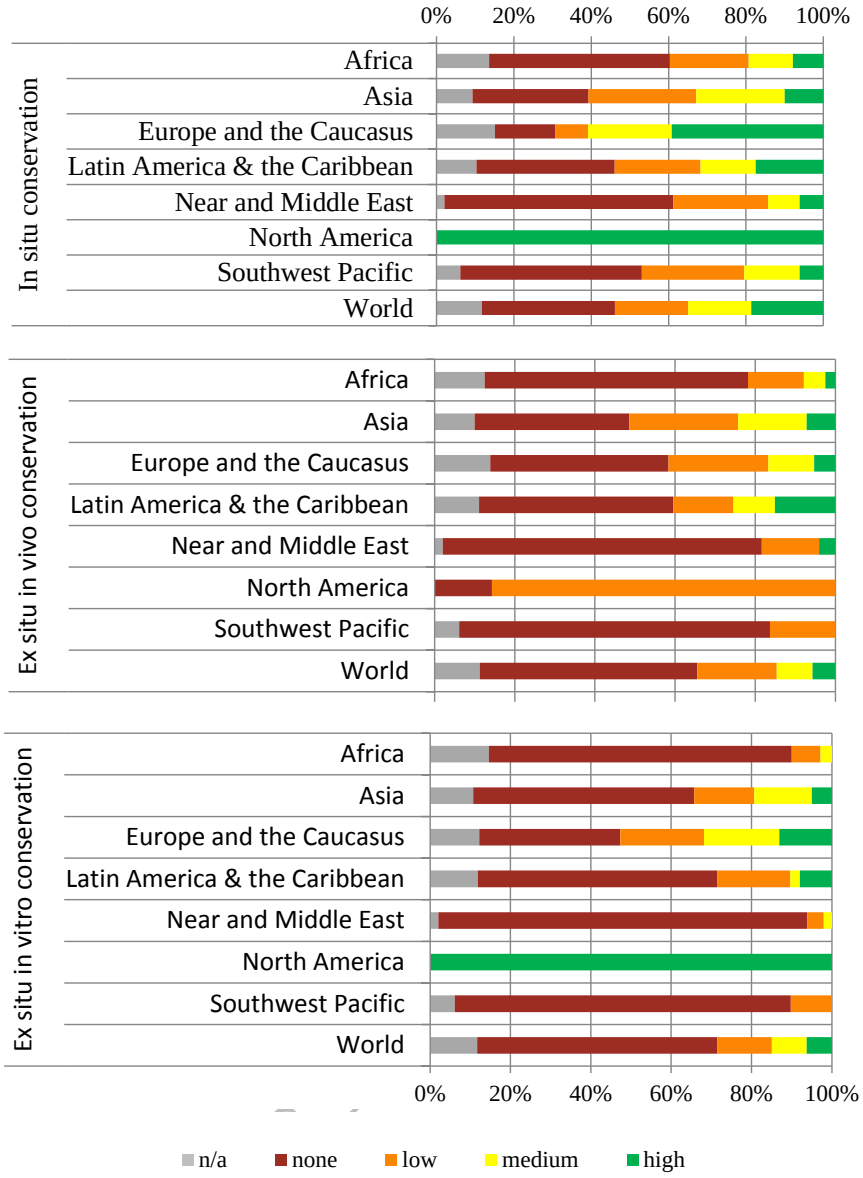
Figure 3C2. Level of breed coverage in conservation activities for the "big five" species – regional breakdowns showing frequency of responses



Notes: The bar charts show the proportion of answers (country × species combinations) from the respective region falling into the various categories of breed coverage (none, low, medium and high) as well as those for which no programmes are reportedly needed because all breeds are secure. Cases where the respective species is not reported to be present in the country are assigned to a separate category (n/a). North America is only represented by the United States of America.

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Table 3C2. Level of breed coverage in conservation activities for the big five species – regional and species breakdown based on average scores

Conservation programs	Species	Africa	Asia	Southwest Pacific	Europe and the Caucasus	Latin America & the Caribbean	North America	Near and Middle East	World
In situ conservation	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								
Ex situ in vivo conservation	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								
Ex situ in vitro conservation	Cattle (specialized dairy)								
	Cattle (specialized beef)								
	Cattle (multipurpose)								
	Sheep								
	Goats								
	Pigs								
	Chickens								

Notes: Scores provided by countries were converted into numerical values (none = 0; low = 1; medium = 2; high = 3). The colours indicate average scores for the countries of the respective region, as shown in the legend (border values assigned to the higher category).

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Box 3C1. Implementing a conservation programme – experiences from China

In 1995, China's Ministry of Agriculture launched a regular budgetary allocation for breed conservation. The annual budget started at 4 million Yuan and increased year by year to reach 54 million Yuan in 2012. In 2013, when the total sum dropped slightly to 50 million Yuan, 156 conservation projects were granted. In addition to training and administrative activities, these projects supported the conservation of more than 100 indigenous breeds. Any private or state-owned farm or company engaged in breed protection can apply to the Ministry of Agriculture for permission to participate in the programme, provided that it:

- is involved in the husbandry of indigenous breeds on the national priority list (under particular circumstances, "newly identified" breeds and/or breeds from underdeveloped provinces may be included, even if these breeds are not on the list);
- is located in the area of origin of the respective breed;
- puts forward proper conservation proposals; and
- is equipped with basic installations and technicians.

Every September, the National Commission for Animal Genetic Resources organizes a group of experts to evaluate applications. About 100 project proposals are selected each year. The National Commission and the group of experts monitor the implementation of the projects and provide training and technical guidance. Conservation farms that are provided with subsidies have to submit reports to the National Commission shortly before the end dates of their projects, i.e. every December. These reports, along with the results of the monitoring activities, are important factors in determining whether support will continue in the following year.

Because funding is limited, conservation priorities have to be determined. Prioritization criteria include: importance to animal production and food security; special genetic characteristics; and risk category.

In 2000, the Ministry of Agriculture issued the first National Animal Genetic Resources Priority List, consisting of 78 indigenous breeds. The list was revised in 2006 and 2014, with the number of breeds rising to 138 and then to 159. As the central government has a limited budget, it encourages provincial governments to formulate provincial priority lists, with the aim of motivating them to contribute. The central government subsidizes breeds on the national-level list and provincial governments subsidize breeds on the provincial lists.

Conserving breeds is a long-term task, and in practice the list of farms and companies applying for conservation projects remains relatively fixed from year to year. For this reason, the Ministry of Agriculture has adopted the strategy of designating State Certified Conservation Farms (one or two per breed on the national priority list). The "state certified" designation does not indicate that the farms are state owned. In fact, most of them are private. The Ministry and the farm enter into a contract under which the Ministry commits to providing subsidies and technical support, while the farm agrees to undertake conversation measures. To date, the Ministry has certified 160 such farms (covering 130 out of the 159 breeds on the national priority list), as well as six gene banks. In addition to these actions by the central government, some provinces have certified provincial conservation farms for the conservation of breeds that are on the respective provincial priority list but not on the national list.

Provided by Hongjie Yang.

Table 3C3. Proportion of countries reporting *in situ* conservation programmes for the five main livestock species

Regions and subregions	Number of countries	Dairy cattle	Beef cattle	Multi- purpose cattle	Sheep	Goats	Pigs	Chickens
		%						
Africa	**40**	37	54	59	51	56	41	47
East Africa	8	57	60	86	43	57	50	38
North & West Africa	20	45	50	64	63	60	50	57
Southern Africa	12	17	55	25	42	50	27	42
Asia	**20**	67	77	71	79	68	67	78
Central Asia	4	100	100	75	100	75	50	75
East Asia	4	33	67	100	50	75	100	100
South Asia	6	60	0	100	80	40	75	80
Southeast Asia	6	67	83	25	83	83	50	67
Southwest Pacific	**7**	67	60	67	67	40	71	71
Europe & the Caucasus	**35**	78	64	90	97	85	89	77
Latin America & the Caribbean	**18**	67	73	50	72	56	61	47
Caribbean	5	100	100	100	80	80	80	60
Central America	5	33	50	33	60	60	60	40
South America	8	60	75	20	75	38	50	43
North America	**1**	100	100	100	100	100	100	100
Near & Middle East	**7**	50	50	33	71	71	0	43
World	**128**	59	64	68	74	67	65	61

Note: The proportions are calculated by dividing the number of countries reporting in situ *programmes for the respective species by the number of countries reporting the presence of breeds in need of conservation, i.e. countries where the respective species is not reported or where all breeds belonging to the species are reported to be secure are excluded from the calculations.*

Table 3C4. Proportion of countries reporting *ex situ in vivo* conservation programmes for the "big five" species

Regions and subregions	Number of countries	Dairy cattle	Beef cattle	Multi- purpose cattle	Sheep	Goats	Pigs	Chickens
		%						
Africa	**40**	26	46	37	34	29	17	9
East Africa	8	29	60	71	14	43	0	13
North & West Africa	20	33	50	27	38	20	23	7
Southern Africa	12	17	36	25	42	33	18	8
Asia	**20**	67	64	43	63	61	60	67
Central Asia	4	50	33	25	50	50	50	50
East Asia	4	33	75	100	50	100	100	100
South Asia	6	80	100	80	80	40	50	80
Southeast Asia	6	83	67	0	67	67	50	50
Southwest Pacific	**7**	33	20	33	33	20	14	29
Europe & the Caucasus	**35**	42	44	48	59	44	50	58
Latin America & the Caribbean	**18**	42	64	33	50	44	50	35
Caribbean	5	50	67	75	60	60	60	20
Central America	5	33	33	33	40	40	40	40
South America	8	40	75	0	50	38	50	43
North America	**1**	0	100	100	100	100	100	100
Near & Middle East	**7**	17	0	33	43	29	0	14
World	**128**	39	49	41	50	41	39	37

Note: The proportions are calculated by dividing the number of countries reporting ex situ in vivo *programmes for the respective species by the number of countries reporting the presence of breeds in need of conservation, i.e. countries where the respective species is not reported or where all breeds belonging the species are reported to be secure are excluded from the calculations.*

Table 3C5. Proportion of countries reporting *ex situ in vitro* conservation programmes for the "big five" species

Regions and subregions	Number of countries	Dairy cattle	Beef cattle	Multi- purpose cattle	Sheep	Goats	Pigs	Chickens
		%						
Africa	**40**	20	32	24	6	9	7	0
East Africa	8	43	60	43	0	0	0	0
North & West Africa	20	9	22	14	7	7	8	0
Southern Africa	12	17	27	25	8	17	9	0
Asia	**20**	50	54	29	42	50	33	33
Central Asia	4	50	33	25	50	50	0	25
East Asia	4	33	67	100	50	100	100	100
South Asia	6	40	0	40	40	20	25	20
Southeast Asia	6	67	67	0	33	50	17	17
Southwest Pacific	**7**	33	20	33	33	20	0	0
Europe & the Caucasus	**35**	74	58	76	76	56	57	35
Latin America & the Caribbean	**18**	50	60	23	35	29	24	7
Caribbean	5	50	67	25	40	40	20	0
Central America	5	75	50	50	25	25	25	0
South America	8	33	63	0	38	25	25	14
North America	**1**	100	100	100	100	100	100	100
Near & Middle East	**7**	0	0	17	14	14	0	0
World	**128**	44	47	41	39	34	29	17

Note: The proportions are calculated by dividing the number of countries reporting ex situ in vivo *programmes for the respective species by the number of countries reporting the presence of breeds in need of conservation, i.e. countries where the respective species is not reported or where all breeds belonging the species are reported to be secure are excluded from the calculations.*

Countries also had the option of providing information on species other than the "big five". The responses are summarized in Table 3C6. Countries that have programmes were probably more likely to respond than those that do not, so it is possible that the relatively high proportion of responding countries that indicate the presence of conservation programmes and the relatively high breed

coverage scores for these species are overestimates. Some of these species are widely distributed, but were only reported on by a few countries. In absolute terms, the number of countries reporting the presence of conservation programmes for some of these species is very low (e.g. eight countries report *in situ* programmes for asses, eight for geese, six for turkeys and ten for ducks).

Table 3C6. Level of breed coverage in conservation programmes for the "minor" species

Species	Number of countries reporting breeds	Number of countries reporting on existance of conservation programme	*In situ* conservation		*Ex situ in vivo* conservation		*Ex situ in vitro* conservation	
			Programmes reported (%)	Score	Programmes reported (%)	Score	Programmes reported (%)	Score
Buffaloes	31	21	81	1.9	62	1.3	52	1.0
Horses	62	47	81	2.1	45	0.9	55	0.9
Asses	30	16	50	1.3	38	0.6	25	0.4
Dromedaries	14	5	60	0.8	20	0.3	20	0.3
Rabbits	43	20	55	1.2	25	0.6	5	0.1
Ducks	43	16	63	1.4	50	0.9	13	0.1
Turkeys	31	12	50	1.0	42	0.6	17	0.2
Geese	28	12	67	1.6	42	0.7	8	0.1
Guinea fowls	20	6	67	1.0	33	0.7	17	0.2

0–0.5 | 0.5–1 | 1–1.5 | 1.5–2 | 2–2.5 | 2.5–3

Low | Medium | High

Notes: The percentages are calculated relative to the number of countries that provided information on the presence or absence of conservation programmes for the respective species. The scores for breed coverage are averages for the responding countries. Scores were converted into numerical values (none = 0; low = 1; medium = 2; high = 3). The colours indicate score categories as shown in the legend (border values assigned to the higher category).

3. The elements of *in situ* conservation programmes

In situ conservation programmes can include a wide range of different activities. The country-report questionnaire requested countries to indicate which activities (from a predefined list) form part of their *in situ* programmes and to indicate whether these activates are operated by the public or private sectors (or both). The twelve potential activities considered in the questionnaire are listed below (grouped into four categories for the purposes of analysis and discussion):

Activities focused on increasing demand of breed products and services

1. *Promotion of niche marketing or other market differentiation (including promotion via association of breed with products having geographical indications or other indicators of origin)*: efforts to promote the marketing of a breed's products to a subgroup of consumers who have particular preferences regarding, for example, product quality, the type of production system (e.g. high animal welfare, organic) or the association of products with particular geographical regions or traditions.[2]
2. *Promotion of at-risk breeds as tourist attractions*: the establishment of specific tourist attractions featuring at-risk breeds (e.g. farm parks) or efforts to promote the keeping of at-risk breeds as elements of attractive landscapes that appeal to tourists.
3. *Use of at-risk breeds in the management of wildlife habitats and landscapes*: situations in which animals belonging to at risk breeds are used deliberately to alter the environment (usually the vegetation) to create habitats suitable for wildlife or landscapes that are considered desirable by humans.
4. *Promotion of breed-related cultural activities*: the promotion of cultural activities such as shows, festivals and sporting events in which at-risk breeds play a role.

[2] Geographical indications or other indicators of origin are schemes that protect (via the regulation of labelling, etc.) the names of agricultural products and foods originating from a particular geographical area or that are produced in a particular way (e.g. using traditional methods and ingredients).

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Activities focused on incentivizing and supporting for livestock keepers

5. *Incentives or subsidy payment schemes for keeping at-risk breeds*: schemes under which livestock keepers receive payment (e.g. from the government) for keeping at-risk breeds.
6. *Recognition/ award programmes for breeders*: schemes in which breeders that make a particular contribution to the conservation and sustainable use of a breed or breeds are honoured or recognized in some way (e.g. a programme of annual awards).
7. *Extension programmes to improve management of at-risk breeds*: programmes that target the keepers of at-risk breeds with advice on how to manage them.
8. *Awareness raising activities on the potential of specific at-risk breeds*: activities that provide livestock keepers (or potential livestock keepers) with information on the potential (e.g. unique traits that may be valuable in particular circumstances) of specific at-risk breeds that might otherwise be overlooked.

Activities focusing on breeding programmes

9. *Conservation breeding programmes:* breeding programmes that maintain breed-specific traits and limit inbreeding.
10. *Selection programmes for increased production or productivity in at-risk breeds:* genetic improvement programmes for at-risk breeds that aim to increase their production and/or productivity and thereby promote their ongoing use by livestock keepers.

Activities focusing on community-level participation and empowerment

11. *Community-based conservation programmes:* Programmes in which the local people are the primary stakeholders responsible for the development and implementation of the activities undertaken to conserve their genetic resource(s).
12. *Development of biocultural protocols:* A document that is developed after a community undertakes a consultative process to outline their core cultural and spiritual values and customary laws relating to their traditional knowledge and resources.

For further discussion of the elements of *in situ* conservation programmes, see Part 4 Section [crossref] and FAO, 2013). The various listed activities are not necessarily completely distinct from each other. In particular, a community-based conservation programme is likely to include one or more of the other activities. Many of the activities are also not necessarily confined to conservation programmes, i.e. they can be implemented for a variety of reasons associated with livestock and rural development, environmental management and so on. The intention in the country-report questionnaire was to identify activities that are part of conservation programmes, i.e. deliberately being used to reduce the risk of genetic erosion or breed extinction. The information provided in the country reports was not always sufficient to determine whether or not this was the case.

The country-report responses are summarized in Tables 3C7 (species breakdown) and 3C8 (regional breakdown). It should be recalled that the figures only indicate the presence of a given activity as an element of conservation programmes within a given country for a given species. The activities are not necessarily widespread or well developed. The data presented in Figures 3C1 and 3C2 and in Table 3C2, indicate that, at least in developing regions, the majority of reported conservation activities are likely to be being undertaken on a limited scale.

Globally, the most commonly reported activity is the implementation of conservation breeding programmes (74 percent of responses[3]) the promotion of niche marketing (68 percent), followed by, awareness-raising activities (63 percent), extension activities aimed at improving the management of at-risk breeds (53 percent) and breeding programmes aimed at increasing productivity in at-risk breeds (51 percent). The other seven activities were reported by fewer than half the countries that have conservation programmes.

The popularity of niche marketing as an element of conservation programmes may be because of its potential to become self-sustaining, eventually removing the need for support from government or

[3] Each response refers to the conservation programme for a given species within a given country (taking the "big five" species into account and treating the three categories of cattle breeds separately).

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other external sources. Niche marketing is reported to be widespread in conservation programmes for all species, although relatively uncommon in programmes for multipurpose cattle. The regional breakdown shows that this approach is less widespread in conservation programmes in Africa and in the Near and Middle East than in other regions. While traditional products from locally adapted breeds are popular in many countries and often command premium prices, establishing a new niche market for products from a breed that is at risk of extinction is challenging. Opportunities are likely to be greater where a substantial number of consumers can afford to pay premium prices and where appropriate legal frameworks are in place (see Part 3 Section [crossref]). An example of niche marketing activities is described in Box 3C2.

Other conservation activities in the category "increasing demand for products and services for at-risk breeds" are far less widely reported than niche marketing. This may, in part, be accounted for by the fact that the number of breeds for which these activities are potentially relevant is lower. For example, use in landscape management is mainly relevant for grazing animals and only in certain locations. It may also be because the "demand" in question is, to varying degrees, for public goods and therefore the activities are unlikely to become self-sustaining on the basis of market demand. Some livestock-related cultural and touristic activities can generate income for keepers of at-risk breeds (trekking with ponies or other animals, charging for entrance to farm parks, etc), but others accrue to the general public or to the local tourism industry more broadly. Conservation grazing is typically organized by public authorities or on a smaller scale by NGOs.

The second most commonly reported element in this category is the promotion of AnGR-related cultural activities. This is reported with roughly the same frequency across the "big five" species. However, it is reported far more frequently in Europe and the Caucasus than elsewhere. Promotion of breeds as tourist attractions is somewhat less frequently reported overall. Again there are no major differences in the frequency with which it is reported for in the various "big five" species, and Europe and the Caucasus is again the region where the activity is most frequently reported. It is also relatively frequently reported in North America and to a lesser extent in Latin America and the Caribbean and Asia. However, it is reported very rarely in the country reports from Africa, the Southwest Pacific and the Near and Middle East.

Use of livestock in the management of wildlife habitats and landscape is reported to be used as an element of breed conservation programmes in only 24 percent of countries that have such programmes. Unsurprisingly, this activity is more commonly reported among types of livestock that are kept in grazing systems (i.e. cattle and small-ruminants among the "big five", plus, in particular, horses). Potential synergy between AnGR conservation and wildlife conservation/landscape management arises because locally adapted breeds, including those that are at risk of extinction, are often well-suited to grazing in grazing in harsh environments and may have other characteristics (including links to local culture) that make them suitable for use in conservation grazing. This activity is again much more commonly reported in Europe and the Caucasus than in other regions. The reports from several European countries, including Finland, Germany, Hungary, the Netherlands and the United Kingdom, specifically note that locally adapted breeds play important roles in the management of landscapes in national parks and other scenic areas.

The country reports indicate that conservation programmes for each of the "big five" species frequently include awareness-raising activities. These activities are also quite widespread in all regions. However, they are particularly widespread in North America and Europe and the Caucasus and relatively rare in Africa and the Near and Middle East. Reported awareness-raising activities extend beyond those aimed at livestock keepers to include those aimed at consumers or the general public. There is therefore some overlap with the above-described "demand creation" category, as consumers may become interested in buying products from at-risk breeds.

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Table 3C7. Proportion of countries reporting the use of each element of *in situ* conservation for each of the main species

In situ conservation programmes elements		Average across species	Dairy cattle	Beef cattle	Multi_ purpose cattle	Sheep	Goats	Pigs	Chickens
Increase demand of breed products and services	Promotion of niche marketing	68	75	68	57	64	72	72	66
	Promotion as tourist attractions	35	28	37	37	40	37	34	33
	Use as management of wildlife habitats and landscape	24	19	28	30	30	28	22	13
	Promotion of breed-related cultural activities	43	33	43	45	45	49	45	43
Incentivazation and support of livestock keepers	Incentives for keeping at-risk breeds	42	39	33	46	47	44	47	37
	Recognition and/or awards	45	54	47	45	48	43	41	39
	Extension to improve the management of at-risk breeds	53	42	47	57	64	58	53	50
	Awareness-raising activities	63	51	62	66	69	66	66	60
Breeding programmes	Conservation breeding	74	61	75	79	78	80	77	66
	Selection for at-risk breeds	51	42	52	55	57	54	53	44
Community-level paticipation and empowerment	Community-based conservation	48	46	42	48	53	49	53	46
	Biocultural community protocols	17	12	18	16	19	20	16	20

Note: Figures indicate the proportion of countries with in situ *conservation programmes for any of the main species.*

In Europe and the Caucasus, consumers and the general public are the main targets of the reported awareness-raising activities, whereas in Asia and Africa activities commonly focus on encouraging livestock keepers to avoid the indiscriminate cross-breeding of locally adapted breeds. Among examples of awareness-raising directed at the general public, the country report from Japan mentions that some breeds have been designated as "national monuments". Channels for awareness raising include museums and zoos (country report of Germany) and schools (country reports of Italy and the Czech Republic) as well as a range of print and electronic media. Social awareness is reported to be increasing in some countries, and in some cases has led to government intervention to support conservation. For example, Mongolia's country report notes that in response to public concerns, the government has been taken steps to help conserve the reindeer kept by the Dukha people, establishing a support programme that will include veterinary extension, financial support and technical advice on reindeer-antler craft.

Extension activities are a relatively common element of conservation programmes for all of the "big five" species and in all regions (more so in Europe and the Caucasus and the Southwest Pacific than elsewhere). The above-described reindeer-focused programme in Mongolia is one example. One circumstance in which there is likely to be a need for a close link between conservation and the provision of advice on livestock keeping is the case of at-risk breeds that are kept predominantly by hobby farmers who are not experienced in animal husbandry and breeding. This may in part explain the frequency with which this activity is reported in Europe and the Caucasus.

Recognition and award schemes for livestock keepers are also reported with moderate frequency. Frequency of reporting is similar in each of the "big five" species, but more common in North America and Europe and the Caucasus than elsewhere.

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Table 3C8. Proportion of countries (among those reporting *in situ* conservation programmes) reporting the use of each element of *in situ* conservation averaged over the main species

In situ conservation programmes elements		World	Africa	Asia	Southwest Pacific	Europe & the Caucasus	Latin America & the Caribbean	North America	Near & Middle East
Increase demand of breed products and services	Promotion of niche marketing	68	43	75	83	78	74	100	47
	Promotion as tourist attractions	35	6	33	3	66	26	43	7
	Use as management of wildlife habitats and landscape	24	4	16	3	49	23	0	7
	Promotion of breed-related cultural activities	43	25	38	19	69	31	14	33
Incentivazation and support of livestock keepers	Incentives for keeping at-risk breeds	42	13	35	27	84	13	0	7
	Recognition and/or awards	45	30	47	34	59	38	100	27
	Extension to improve the management of at-risk breeds	53	41	43	60	74	37	43	34
	Awareness-raising activities	63	43	62	67	83	48	100	31
Breeding programmes	Conservation programs	74	67	74	32	87	72	43	60
	Selection programs in at-risk breeds	51	34	53	29	65	54	100	27
Community-level paticipation and empowerment	Community-based conservation	48	41	75	53	47	35	29	39
	Biocultural community protocols	17	17	24	7	16	23	0	7

Note: The figures correspond to the number of countries reporting the respective activity divided by the number of countries reporting in situ conservation for the respective species, averaged over the "big five" species.

The provision of economic incentives to livestock keepers raising at risk-breeds is widely used in Europe and the Caucasus as a core element of *in situ* conservation programmes, but is very rare in other regions. The Southwest Pacific is a partial exception because, in New Zealand, the Rare Breeds Conservation Society of New Zealand, which is the main operator of conservation programmes in the country, gives small grants to livestock keepers keeping at-risk breeds (country report New Zealand). This is the only reported case in which financial incentives are paid by a private institution rather than by the government of the respective country. Many European Union member countries use allocations from the EU Rural Development Programme to support the conservation of AnGR within their jurisdictions by providing payments to those keeping at-risk local breeds. Reported examples from other regions include the provision of financial support to the keepers of some locally adapted breeds of cattle goats and chickens in Indonesia (country report Indonesia).

Both breeding programmes involving conservation breeding and those that aim to increase the productivity of at-risk breeds are widely reported as elements of *in situ* conservation programmes. Conservation breeding is the more widely reported. While it is more frequently reported in Europe and the Caucasus than elsewhere, it is also reported quite frequently in some developing regions. Governmental farms and nucleus herds play a key role in these activities in most regions (see below). In the case of both types of programme, there are no major differences in frequency between species. In some cases, the information provided in the country reports from Africa, Asia and Latin America and the Caribbean suggest that conservation breeding programmes and breeding programmes focusing on improving performance are not clearly distinguished. Some of the programmes referred to as conservation breeding programmes aim to contribute to conservation by improving the production traits of the targeted breeds.

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Community-based conservation is more commonly reported in Asia than in any other region (75 percent compared to an average of 48 percent). As noted above, this activity clearly overlaps with others. There are several examples of successful involvement of communities in *in situ* conservation of breeds (Box 3C2). Biocultural community protocols (see Part 4 Box) [crossref] are not very widely reported (17 percent overall). Initiatives of this kind are a relatively new phenomenon and relevant only in certain circumstances.

Box 3C2. Dyeing sheep wool naturally in 35 colours: indigenous production systems and associated traditional knowledge – a case from Argentina

The women of the Qom ethnic group of the province of Formosa, Argentina, practise artisanal handicrafts using wool from the local sheep, which has traditionally been raised in a "backyard" production system. Because of the coarseness of the wool, the items produced include carpets and tapestries. The women and children take responsibility for managing the small animals, while the men attend to the cattle. The flocks are small. Twice a year, the animals are sheared by the women, who collect the wool and process it according to their needs. For generations, Qom women have preserved local knowledge of how to use natural dyes extracted from bark, roots, leaves, fruits and insects. Efforts have been made to identify the natural resources used by the women throughout the handicraft production chain, with the aim of improving the quality and utilization of these materials, and thereby improving the entire production chain and empowering the women. In this way, 35 colours obtained from natural sources and used to dye fibres have been identified. Phenotypic, production and genetic characterization studies, along with studies of population dynamics, are being undertaken in the local sheep population, whose fleeces possess unique characteristics that make them suitable for the type of fabric production for which they have been used for generations. Women's associations, in the form of artisan centres, have played a participatory and permanent role in the process, evaluating the impact that the interventions are having on their production activities. They have improved the quality of the craft products, and thereby achieved greater market penetration. The process has also contributed to improving the women's visibility as new social actors and to strengthening their political involvement and participation. Today, the artisan centres lead the innovation of the production process, transforming an artisanal practice associated with the past and the older generations into an innovative and dynamic livelihood activity that involves young people and opens new employment perspectives for the region's indigenous communities.

Provided by Sebastián de la Rosa.

4. The roles of the public and private sectors in *in situ* conservation programmes

Public institutions are involved in the direct implementation of the majority of the elements of *in situ* conservation programmes in most countries where such programmes exist (Figure 3C3). In Africa and Asia, public institutions are the main operators of all *in situ* conservation activities implemented, except for the promotion of breed-related niche market products. In Europe and the Caucasus and Latin America and the Caribbean, both public and private institutions are equally involved in conservation actions. In Europe and the Caucasus, private institutions are more involved in the development of the niche marketing of breed-related products and in the promotion of breed-related cultural and touristic activities, whereas the involvement of public institutions is concentrated mainly in the implementation of conservation breeding programmes and in extension programmes to improve the management of at-risk breeds. In the United States of America, Australia[4] and New Zealand, public institutions play a minor role in the implementation of *in situ* conservation activities. The country report from the United States of America for example, indicates that public-sector activity in the field of conservation is largely confined to the gene banking of cryoconserved material, while *in situ* conservation is handled largely by breeders' associations.

[4] *Australia did not provide a country report as part of the second SoW-AnGR reporting process. However, it published a report as an independent initiative in 2012.*

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Breeders' associations are also heavily involved in *in situ* conservation in Europe and the Caucasus and to some extent in South America. They manage breeding programmes focusing on conservation and/or performance improvement and collaborate in the development of niche marketing and touristic and cultural activities (see Part 3 Section [crossref] for a general discussion of stakeholder involvement in breeding programmes). In some European countries, breeders' associations are reported to be the primary stakeholders in *in situ* conservation, operating with some support from NGOs (Box 3C3) and government (e.g. country reports of the Netherlands and the United Kingdom).

Globally, public institutions play a key role in breeding programmes focusing on conservation and/or performance improvement (Figure 3C3). In the majority of African, Asian and to a lesser extent in South American countries, national governments are the main, and usually only, operators of breeding programmes. In the majority of the countries in these regions, governments manage nucleus farms where locally adapted and/ or exotic animals are kept. These nucleus farms distribute breeding stock (males) to improve populations owned by livestock keepers. Schemes of this kind can play an important role in the conservation and development of at-risk breeds.

The provision of funding is a key element of the public sector's role in AnGR conservation. For example, governments may provide financial support for *in situ* conservation activities carried out by breeders' associations, cooperatives, livestock keepers organized at community level or NGOs. They may also provide direct financial incentives to livestock keepers who keep at-risk breeds. Payments of this kind play an important role in Europe and the Caucasus and in some countries in Asia, but are almost absent in the rest of the world. Governments play also a key role in extension activities aimed at improving the management of locally adapted and at-risk breeds. This role is significant even in countries such as the United States of America, where the government generally has little involvement in *in situ* conservation.

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Box 3C3. The conservation network for the Finnish Landrace chicken

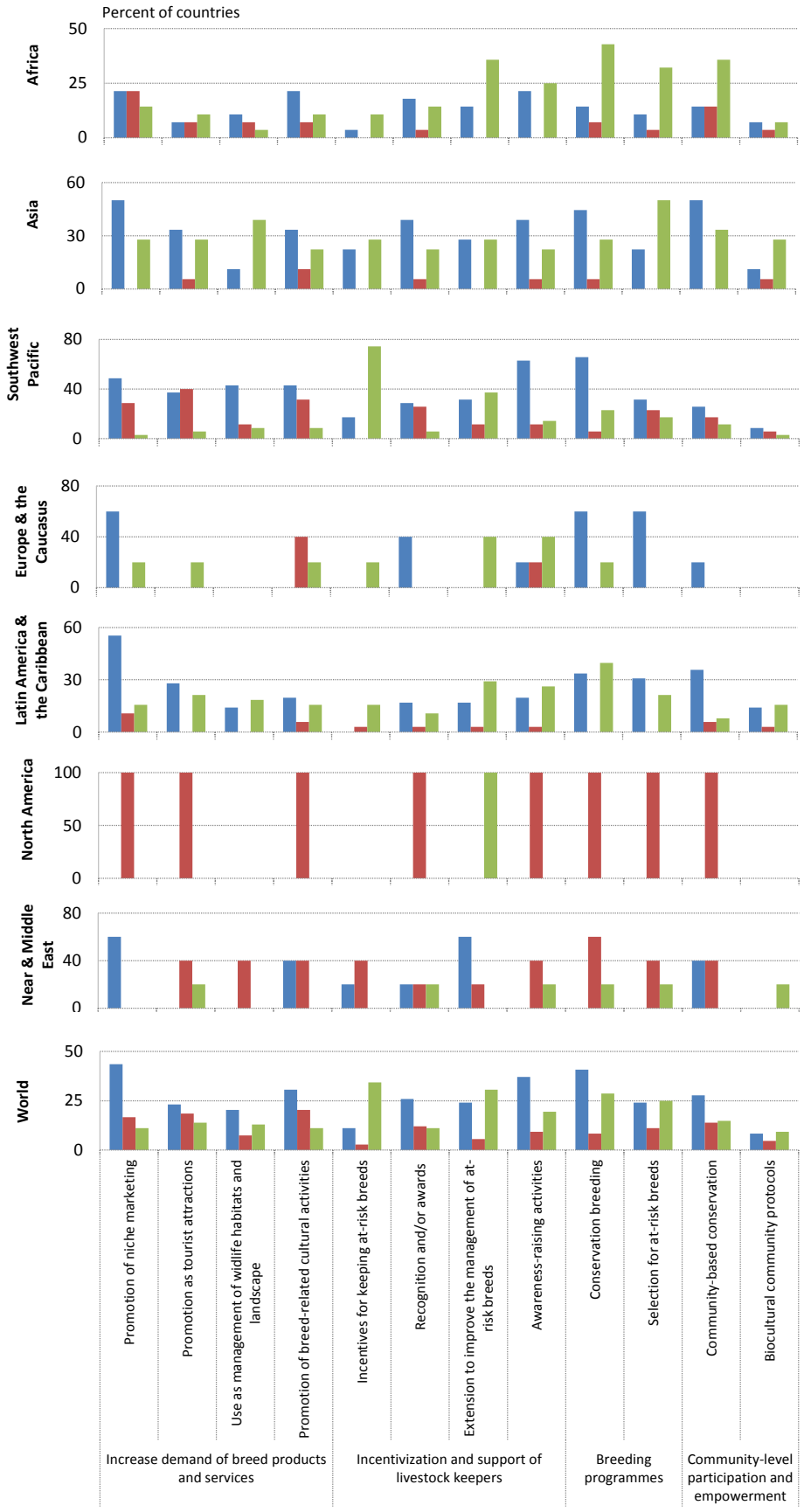
The Finnish Landrace chicken breed is descended from several landrace chicken populations that existed in Finland before industrialized egg production began. By the late 1990s, the breed was at risk because of cross-breeding with exotic breeds. Twelve different lines or families of the Finnish Landrace chicken survived in remote villages. These populations now represent the core of the conservation programme, established in 1998 with the aim of maintaining the breed's purity and its genetic and phenotypic diversity. The programme is based on a network of more than 300 hobby breeders and is coordinated by MTT Agrifood Research Finland. New breeders are welcome to join the network. When they do so, they sign a contract with MTT Agrifood Research Finland, agreeing to follow the rules of the programme.

Network members submit annual reports to MTT, providing information on, inter alia, the number of breeding females and males that they have at the end of a year, the brooding success, the phenotypic traits of their birds and eggs, and their sales of chicks and adult birds to other Landrace chicken breeders. MTT is responsible for maintaining the database, communication and information gathering. MTT organizes annual meetings and courses and provides advisory services. A four-member advisory group supports the coordination of the programme and provides expert practical advice to the network. Poultry farming organizations, such as the Finnish Poultry Association, as well as the Finnish Food Safety Authority EVIRA, contribute knowledge to the programme.

Currently, the hobby breeders in the network have more than 5 000 Finnish Landrace hens and breeding roosters. The modern trend of raising "city chickens" in urban areas has increased the popularity of the Landrace chicken. The various lines and families are kept apart to prevent crossing. The genetic diversity of the lines and the relationships among them are currently being investigated using whole-genome SNP-marker analysis. The studies should provide new information that will help in the implementation of the conservation work, possibly including the exchange of genetic material among some closely related lines.

Provided by Mervi Honkatukia, National Coordinator for the Management of Animal Genetic Resources, Finland.

Figure 3C3. Involvement of public and private institutions in the implementation of *in situ* conservation programmes elements



Box 3C4. Iberian pigs in Spain – sustained through product labelling

As described in a text box in the first SoW-AnGR,[5] the population size of the Iberian pig declined from the 1960s to the 1980s, after which time it recovered thanks to successful marketing efforts focusing on the quality of its meat. Unfortunately, the rising population led eventually to overproduction of Iberian breed products and triggered a sector crisis that led to a sharp decrease in the breed's population, which went from 4.1 million pigs marketed in 2008 to 2.0 million in 2013.[6]
To resolve these issues, Spain's Ministry of Agriculture introduced legislation[7] specifically regulating the labelling of all products from Iberian pigs, with the aim of clarifying the features of the products to consumers, avoiding product fraud and supporting farmers producing high-quality Iberian pigs. The labels are defined so as to distinguish the quality of the products according to the genetic purity of the animals and the characteristics of the farming system. Four labels are differentiated by colour:

- Black label: products from animals that are pure-bred Iberian and that feed only on acorns in extensive farming systems in dehesa forests;
- Red label: products from Iberian–Duroc cross-bred animals (always at least 50 percent Iberian) that feed only on acorns in extensive systems in dehesa forest.
- Green label: products from pure-bred or cross-bred Iberian pigs (always at least 50 percent Iberian) that are fed on concentrates in extensive or outdoor intensive systems;
- White label: products from pure-bred or cross-bred animals fed on concentrates in intensive indoor systems.

Red, green and white labels have to clearly indicate the breed composition of the animals, specifying the percentage of Iberian breed genetics.

5. *Ex situ in vitro* conservation programmes

Almost half (45 percent) of reporting countries indicate that they have an operational *in vitro* gene bank for AnGR. A further 32 percent report that they have plans to develop one (Figure 3C2). In addition to North America (represented in the country reporting only by the United States of America) gene banks are widespread in Europe and the Caucasus (71 percent of reporting countries), East Asia (100 percent), Southeast Asia (67 percent) and South America (63 percent). Note that a higher percentage of countries reported *ex situ in vitro* conservation programmes (Table 3C1) than AnGR gene banks (Figure 3C2 and Table 3C9). The discrepancy is accounted for mainly by the fact that some countries that do not have gene banks report the storage of genetic material for use in research or breeding programmes or for conservation purposes within the framework of projects with limited scope.

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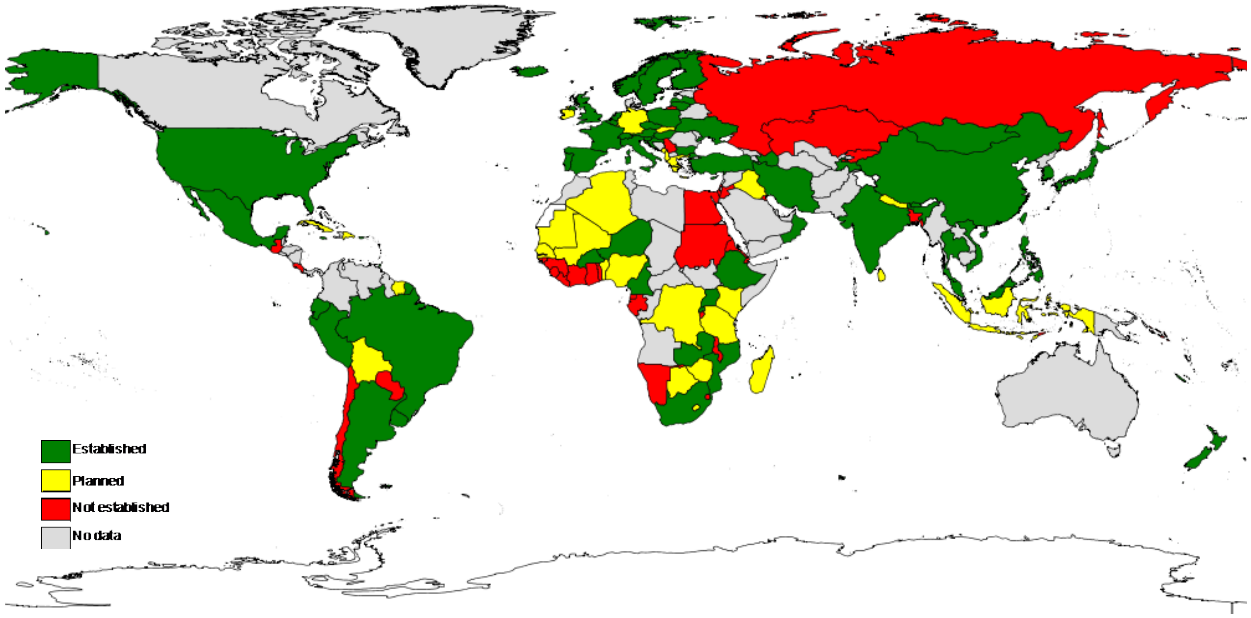
[5] Box 20. Sustainable utilization of the Iberian pig in Spain – a success story (page 144).
[6] Data from Asociación interprofesional del cerdo ibérico (available in Spanish at http://www.cerdoiberico.es).
[7] Real Decreto 4/2014, de 10 de enero, por el que se aprueba la norma de calidad para la carne, el jamón, la paleta y la caña de lomo ibérico (available in Spanish at http://www.boe.es/diario_boe/txt.php?id=BOE-A-2014-318).

Table 3C9. Proportion of countries reporting the presence of *in vitro* gene banks, the storage of different types of types of genetic material, and plans for international collaboration in gene banking

Regions and subregions	Number of countries	Proportion of countries reporting AnGR gene bank	Proportion of countries among those reporting AnGR genebanks, storing materials					Proportion of countries planning subregional or regional collaboration
			Semen	Embryos	Oocytes	Somatic cells	Isolated DNA	
		(%)						
Africa	**9**	**23**	**100**	**44**	**11**	**11**	**22**	**33**
East Africa	3	38	100	67	0	0	0	13
North & West Africa	3	15	100	33	33	0	33	40
Southern Africa	3	25	100	33	0	33	33	33
Asia	**12**	**60**	**100**	**67**	**42**	**42**	**67**	**30**
Central Asia	2	50	100	50	50	0	50	25
East Asia	4	100	100	100	50	75	75	0
South Asia	2	33	100	0	0	0	100	17
Southeast Asia	4	67	100	75	50	50	50	67
Southwest Pacific	**1**	**14**	**100**	**100**	**0**	**0**	**0**	**14**
Europe & the Caucasus	**25**	**71**	**100**	**64**	**16**	**48**	**60**	**46**
Latin America & the Caribbean	**8**	**44**	**88**	**75**	**25**	**38**	**38**	**11**
Caribbean	2	40	100	50	0	0	0	20
Central America	1	20	100	100	0	0	0	0
South America	5	63	80	80	40	60	60	13
North America	**1**	**100**	**100**	**100**	**100**	**100**	**100**	**0**
Near & Middle East	**1**	**14**	**100**	**0**	**0**	**0**	**100**	**14**
World	**57**	**45**	**98**	**63**	**23**	**39**	**53**	**30**

Table 3C10 shows the percentage of national breed populations ("big five" species) reported to be cryoconserved in each region and subregion. This shows that despite the large number of countries that have established gene banks, only a small number of national breed populations are conserved: cattle (27 percent), sheep (23 percent), goats (20 percent), pigs (18 percent) and chickens (6 percent). The United States of America is the only country where the majority of national cattle, sheep, goat and pig breed populations are conserved *in vitro*. The proportion of breed populations with sufficient material stored to allow them to be reconstituted in case of need is even lower.

Figure 3C4. State of development of *in vitro* gene banks for animal genetic resources



Source: Country Reports.

Table 3C10. Breed coverage of the "big five" species in gene banks

Region and subregions		Reported proportion of national breed populations conserved in AnGR gene banks				
		Cattle	Sheep	Goats	Pigs	Chickens
		%				
Africa	Conserved	12	6	5	3	2
	Enough material	8	6	4	3	2
East Africa	Conserved	14	0	0	0	0
	Enough material	12	0	0	0	0
North & West Africa	Conserved	12	10	5	4	0
	Enough material	12	10	5	4	0
Southern Africa	Conserved	9	5	8	4	5
	Enough material	0	5	5	4	5
Asia	Conserved	32	24	24	19	19
	Enough material	15	9	11	10	8
Central Asia	Conserved	19	10	14	0	0
	Enough material	12	7	10	0	0
East Asia	Conserved	40	45	31	24	32
	Enough material	26	20	15	14	16
South Asia	Conserved	32	7	8	4	6
	Enough material	9	2	4	0	0
Southeast Asia	Conserved	29	31	34	20	11
	Enough material	10	3	10	9	0
Southwest Pacific	Conserved	0	0	0	0	0
	Enough material	0	0	0	0	0
Europe & the Caucasus	Conserved	40	27	28	27	5
	Enough material	23	10	12	12	3
Latin America & the Caribbean	Conserved	15	15	15	5	0
	Enough material	12	10	7	5	0
Caribbean	Conserved	13	21	23	12	0
	Enough material	7	4	9	12	0
Central America	Conserved	4	0	9	0	0
	Enough material	4	0	9	0	1
South America	Conserved	22	19	15	6	0
	Enough material	17	15	5	5	0
North America	Conserved	74	67	88	92	25
	Enough material	33	12	13	42	3
Near & Middle East	Conserved	4	0	0	0	0
	Enough material	4	0	0	0	0
World	Conserved	27	23	20	18	6
	Enough material	16	9	9	9	3

Note: "Conserved" = some material stored in a gene bank; "Enough material" = enough material stored to allow the breed to be reconstituted.

Countries also had the option of providing information on *ex situ in vitro* conservation in species other than the big five. The responses are summarized in Table 3C11. Note that answering the question was not compulsory and therefore it is possible that some countries that have genetic material from these species stored in their gene banks did not provide information. The reported proportion of buffalo breed populations with material stored is similar to that for cattle (although the absolute number is clearly much lower). In horses and rabbits, widely distributed species with large numbers of reported breeds, the figures are substantially lower, at 8 percent and 9 percent, respectively. A similar proportion (but lower absolute numbers) is reported for asses. Material from several other mammalian species (dromedaries, Bactrian camels, alpacas, llamas and yaks) is reported to be stored in gene banks. These species do not have worldwide distribution and the total number of reported breeds is low. In all cases material from between 10 and 30 percent of breed populations is reported to be stored in gene banks. In absolute terms, this amounts to a handful of breed populations in all cases. In all "minor" mammalian species, the number of breed populations for which sufficient material is stored to allow them to be reconstituted is either low or none. The figures for avian species are almost all very low. Muscovy ducks are something of an exception (material from 43 percent of 21 breed populations reported to be stored – and in all cases in sufficient quantity to allow the breeds to be reconstituted).

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Table 3C11. Breed coverage of "minor" species in gene banks

Species	Total number of national breed populations reported	Proportion of national breed populations from which some material is stored in a gene bank	Proportion of national breed populations from which sufficient material is stored in a gene bank to allow the breed to be reconstituted
		%	
Horses	1317	8	2
Rabbits	586	9	9
Ducks	311	3	2
Pigeons	285	0	0
Geese	278	0	0
Turkeys	127	1	1
Buffaloes	85	27	15
Asses	74	8	1
Guinea fowls	51	0	0
Dromedaries	45	13	0
Quails	43	2	0
Muscovy ducks	21	43	43
Ostriches	20	5	5
Deer	18	0	0
Guinea pigs	12	0	0
Alpacas	12	17	0
Llamas	11	18	0
Bactrian camels	7	14	0
Yaks	6	17	0

Note: The total number of national breed populations reported refers to the number reported in the country reports. The proportions are calculated relative to this total number of reported breeds. Providing information on the gene banking of material from these species was optional. It is possible that some countries that did not provide information also have some material from these species stored in their gene banks.

Countries that have national gene banks were requested to provide further information on the contents of the collection, the operation of the gene bank (stakeholder involvement) and the purposes for which the stored material is, or has been, used. Responses are summarized in Tables 3C9 and 3C12. Semen is by far the most commonly stored material, followed by embryos, but isolated DNA, somatic cells and oocytes are stored in a substantial number of gene banks. There is some regional variation. For example, more than half the African countries reporting the presence of gene banks indicate that they store no material other than semen. The use of gene banks to store material from breeds that are not currently regarded as being at risk of extinction is quite widespread (53 percent of responses[8]). This material has the potential to serve as an ultimate backup should some major unexpected disaster strike the *in vivo* population, but it can also be used in less extreme circumstances, for example, to introduce the genetic variation needed to a re-orientate a breeding programme in response to changing market demand (FAO, 2012).

While a gene bank is a strategic national resource, the most direct beneficiaries (or potential beneficiaries) are livestock breeders. The involvement of stakeholders from the breeding sector in the planning of the development and operation of the gene bank is therefore likely to be important in ensuring that it is well targeted and operates effectively (ibid.). However, only a minority of responses indicate that livestock keepers or breeders' associations are involved in the operation of the reported gene banks.

[8] Responses = country × species combinations.

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The number of cases in which genetic material from gene banks is reported to have been used to increase the genetic variability in *in situ* or *ex situ* populations is rather limited (26 and 18 percent of responses, respectively) and the country reports generally did not provide detailed information on such activities. Only a very few cases of gene bank material being used to reconstitute extinct or nearly extinct breeds are reported and few details are provided. Box 3C5 describes the reconstitution of a discontinued research line from cryoconserved material. Only a minority of countries (around 30%) globally report that they are involved in international or regional collaboration in AnGR gene banking. These cases are discussed in the regional summaries below.

Table 3C12. Characteristics and functions of national gene banks

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in ex situ population	Increase genetic variability in in situ population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	35	30	31	33	4
East Africa	3	17	17	11	17	0
North & West Africa	3	61	56	61	61	0
Southern Africa	3	28	17	22	22	11
Asia	**12**	67	26	35	29	4
Central Asia	2	67	42	58	67	0
East Asia	4	63	17	17	25	4
South Asia	2	67	25	0	8	0
Southeast Asia	4	71	25	54	21	8
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	58	61	10	24	1
Latin America & the Caribbean	**8**	40	27	2	19	0
Caribbean	2	42	0	0	0	0
Central America	1	33	50	0	0	0
South America	5	37	33	3	30	0
North America	**1**	100	100	83	67	17
Near & Middle East	**1**	17	0	0	17	0
World	**57**	53	42	18	26	2

Note: "Number of countries" = the number of countries that provided information on the characteristics of their national gene bank. The figures represent the proportion of responses (country × species combinations) that indicate the presence of the respective activity. The figures refer only to the "big five" species (cattle, sheep, goats, pigs and chickens).

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Box 3C5. Reconstituting a research pig line

Gene banks have an important role in backing up research populations. Purdue University in the United States of America had developed a line of pigs that were either homozygous or heterozygous for both the Napole and Halothane genes, which negatively affect pork quality in animals with the homozygous recessive genotype. In 2003, Purdue decided to discontinue this population and chose to have samples of semen from three carrier boars frozen and banked by the National Animal Germplasm Program. In August 2007, the University decided to re-establish a population in which the recessive homozygous condition was present so that it could be used to research meat quality. Samples of the semen stored with the National Animal Germplasm Program were therefore transferred back to Purdue and sows were inseminated. The results were a 100 percent pregnancy rate and an average litter size of 7.7 pigs. The resulting boars were genotyped, and 14 of 25 were found to be heterozygous for both genes. With the F2 population, several boars were homozygous for both mutant genes. This case was the first in which a livestock research line was cryopreserved, discontinued, and re-established using germplasm frozen and stored by a gene bank.

Source: Reproduced from FAO, 2012.

6. Regional summaries

In situ conservation programmes in Asia are government driven and focus primarily on extension activities and breeding programmes aimed at improving breeds' productivity. In East Asia, well-developed *in situ* conservation programmes are in place in some countries. Although there is some private-sector involvement, governments are the main operators. The most widely used activities in this subregion are awareness raising, conservation breeding programmes, the promotion of niche market products and community-based conservation programmes. In South and Southeast Asia, a lot attention is paid to awareness-raising activities. For example, the country reports from Indonesia and the Philippines, mention the use of internet and social media in addition to traditional means of promoting locally adapted breeds. There is also some focus on the establishment of breeding programmes for at-risk breeds. The country report from India mentions several examples of such schemes for small-ruminant breeds.

More than half (60 percent) of country reports from Asia indicate the presence of a gene bank. However, there are substantial differences between the subregions (Table 3C9). In general, the AnGR gene banks in East and Southeast Asia are more developed than those in the other two subregions. A higher proportion of breeds in every species is conserved in the gene banks of East and South East Asia than those of Central and South Asia (Table 3C10). East Asia has a higher proportion of its chicken breeds stored in gene banks than any other subregion or region in the world. This is mainly a result of the presence of well-developed gene banks in China and Japan. Although gene banks are relatively uncommon in the reporting countries in Central and South Asia, some countries from these subregions report well-developed gene banks. The gene bank of the Islamic Republic of Iran, for example, includes genetic material in the form of semen, embryos, oocytes and isolated DNA from cattle, sheep, goats, horses, buffaloes, Bactrian camels and dromedaries. Material from the gene bank has been used to introduce genetic variability into *in situ* and *ex situ* populations. The gene bank of India includes semen and isolated DNA from cattle, sheep, goats, buffalos, horses and asses. Cattle genetic material from the gene bank has been used to increase the genetic variability and population sizes of breeds such as the Tharparkar, Sahiwal, Krishna Valley and Hariana. In Southeast Asia, Malaysia, Philippines, Thailand and Viet Nam report the presence of gene banks, while Indonesia reports plans to develop one. These gene banks are used mainly for introducing genetic variability into breeding programmes involving *ex situ* populations. With regard to international collaboration in gene banking within the region, the country report from the Philippines mentions plans for collaboration between India, Pakistan and the Philippines in the *ex situ in vitro* conservation of buffaloes.

In Africa, as in Asia, the main elements of *in situ* conservation are extension activities and breeding programmes focusing on conservation and/or performance improvement. State farms again play a

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central role. There are some differences between the subregions of Africa. Most notably, *in situ* conservation programmes in Southern Africa are more diverse than those in other subregions in terms of the elements they include. The private sector, including breeders' associations, is also more involved.

In vitro conservation is not widespread in Africa. The majority of countries report that they have no gene bank and the proportion of breeds covered is low (Table 3C9 and 3C10). However, several country reports mention plans to establish subregional gene banks in Africa. The report from Uganda mentions the objective of developing a gene bank in collaboration with Burundi, Kenya, Rwanda, South Sudan and the United Republic of Tanzania. The report from Togo mentions plans to collaborate with other countries of the Economic and Monetary Union of West Africa to create a regional bank or strengthen the capacity of the gene bank of the International Centre of Research and Development of Livestock in Zone Subhumid, based in Burkina Faso. The report from South Africa mentions intentions to collaborate with other Southern African Development Community countries (Botswana, Mozambique, Namibia, Zambia and Zimbabwe).

In situ conservation programmes in Europe and the Caucasus are well developed and generally involve a range of different elements (Tables A3C1 to A3C7). The majority of locally adapted breeds are well characterized and their population trends are monitored. Breeders' associations are widespread and conservation breeding programmes or those aiming to increasing the productivity of at-risk breeds are common. A lot of effort is put into awareness raising activities and the methods used are diverse. The provision of direct financial incentives to the keepers of at-risk breeds is more common in this region than anywhere else in the world. The same is true for the use of at-risk breeds in the management of landscapes and wildlife habitats and their use in touristic activities. Niche marketing of breed products is well developed, facilitated by the existence of labelling schemes such as those in the European Union for protected designations of origin. The majority of the countries in the region report well-established AnGR gene banks. However, the breed coverage of *ex situ in vitro* programmes remains far from complete: material from 40 percent of the reported cattle breeds and less than 30 percent of reported sheep, goats and pigs breeds is stored in gene banks. Chickens are even less well represented, with only 5 percent of the reported breeds included in gene banks (Table 3C10).

Box 3C6. Switzerland's virtual national gene bank – building on the work of the commercial sector

Switzerland is fortunate enough to have gene banks in place for a number of species, including cattle, pigs, goats and horses. These gene banks are run by commercial artificial insemination (AI) companies, except for the horse gene bank, which is run by the government.

Following the adoption of the Global Plan of Action for Animal Genetic Resources, Switzerland committed itself to, among other priorities, strengthening its *ex situ* conservation measures. At the time, however, it had no proper national gene bank in place. Moreover, building up the full infrastructure needed to run a gene bank is a very costly process.

In 1960, Swissgenetics, a private commercial company, started to freeze and stock semen from bulls belonging to various cattle breeds for AI, as well as for long-term storage. Since about 1975, Swissgenetics has been systematically storing bovine semen in its own gene bank. The existence of this long-established store of frozen semen, and the fact that the company was willing to cooperate, represented a big opportunity for the government. The obvious approach was to join forces to fulfil the objective of establishing a national gene bank.

The Swiss Federal Office for Agriculture (FOAG) found a very reliable partner in Swissgenetics. The company agreed to place the core semen collection at the disposal of the government and to provide backup facilities for long-term storage. FOAG agreed to compensate these efforts with an annual financial contribution.

The contractual arrangements were signed in 2010 for a period of ten years, extendable for further periods of ten years. It was concluded that 30 doses of already-frozen semen from bulls belonging to Swiss breeds would be assigned to the virtual national gene bank. Since 2010, 50 semen doses from each new Swiss bull entering the AI station have been allocated to the virtual gene bank's core

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collection. The organization administrates the doses using the CryoWEB software.[9] If necessary and mutually agreed, frozen semen from the core collection can be used for genetic-scientific or genetic-economic purposes or for the revitalization of breeds that are at risk of extinction. Swissgenetics also hosts the gene bank for goat breeds.
This collaboration between a commercial AI company and the government in building a virtual national gene bank has been very successful so far. In 2012, FOAG succeeded in establishing a similar contract with Suisag, a commercial pig AI company.

Provided by Catherine Marguerat, National Coordinator for the Management of Animal Genetic Resources, Switzerland.

Two types of gene banks are reported in this region: centralized national gene banks (e.g. Poland and Spain) and dispersed gene banks managed by different stakeholders (breeders' associations, research institutions, NGOs, commercial companies) (e.g. Italy and the United Kingdom). Germany is planning to do develop a national gene bank in the form of a network of gene banks operated by different partners. Switzerland's establishment of a "virtual gene bank" in collaboration with the private sector is described in Box 3C6. Despite the generally well advanced state of *ex situ in vitro* conservation in this region, several countries have no gene banks and have no plans to establish them (Figure 3C4). A network of gene banks involving 23 countries is being developed (Box 3C7).

Box 3C7. Development of the European Gene Bank Network for Animal Genetic Resources

European countries have established national gene banks for *ex situ in vitro* conservation of animal genetic resources (AnGR) as a complementary strategy to *in situ* conservation. Although countries take responsibility for the development of gene bank collections at national level, there are clear advantages to collaboration between countries at regional, subregional or bilateral levels.
The European Regional Focal Point on Animal Genetic Resources (ERFP) has established a Working Group on *Ex Situ* Conservation of Animal Genetic Resources.[10] The main tasks of this Working Group are to: i) exchange experiences and knowledge among European countries; ii) support the establishment, development, efficiency and effectiveness of European national gene banks; and iii) to jointly develop a European strategy for gene banking, documentation and other related issues.
In 2013, first steps were taken, under the umbrella of the ERFP, to officially establish the European Genebank Network for Animal Genetic Resources (EUGENA). The objective is to support *ex situ* conservation and sustainable use of AnGR in Europe under common terms of agreement. In this context, a national gene bank for AnGR is defined as a repository (or more than one repository collaborating in a network at national level) that undertakes *ex situ* conservation and sustainable use of AnGR and is held by a host institution authorized and/or recognized by a national authority to fulfil these tasks. There are ample opportunities for the development of a more efficient, rational and long-term regionally integrated approach to conservation at the European level. When resources are limited, it is important to set priorities and to avoid gaps and duplication of efforts. Through a regional approach, the quality standards of national gene banks could be further developed and enhanced. A regional portal or documentation system should provide easy access to information about national collections.
The objectives of EUGENA are to:

- support gene banks in fulfilling their individual roles and objectives;
- improve the monitoring and assessment of AnGR kept in *ex situ* collections in European countries by sharing information;
- improve gene bank operations and procedures in European countries by sharing information;
- create synergies in *ex situ* conservation and sustainable use by promoting joint activities among European gene banks;
- increase the efficiency of *ex situ* conservation of transboundary breeds;
- promote the harmonization of acquisition and access terms for *ex situ* conservation across European countries;

[9] http://cryoweb.tzv.fal.de/
[10] http://www.rfp-europe.org/index.php?id=597

- facilitate improvements in the quality of *ex situ* collections in European gene banks;
- create an element of the European research infrastructure to address the conservation and sustainable use of AnGR; and
- facilitate a European approach to international cooperation and exchange of AnGR in the context of the Nagoya Protocol on Access and Benefit Sharing.

A survey was undertaken to generate an overview of the key characteristics of national gene banks in Europe, including legal and institutional aspects, the history of the collections, their objectives and their documentation. The survey identified similarities and differences among countries and issues that needed harmonization at European level and was thus an important first step towards facilitating the further development of EUGENA.
National governments are expected to further rationalize their national strategies on the conservation and sustainable use of AnGR, including national gene banking strategies. At present, not all valuable genetic diversity under the custody of breeders and researchers has been cryoconserved for the long term in a national gene bank. Besides complementing and enhancing gene bank collections, there is also a need to promote future use of gene bank collections, including through better characterization and documentation of collections.

Provided by Sipke-Joost Hiemstra, National Coordinator for the Management of Animal Genetic Resources, the Netherlands.

In situ conservation programmes in Latin America and the Caribbean involve both government and private initiatives. The main elements of these programmes in this region are breeding programmes focusing on conservation and/or performance improvement, in which governmental nucleus farms play a key role, promotion of niche marketing products and awareness-raising activities. However, there is great diversity within the region in terms of the types of conservation activities undertaken (Tables A3C1 to A3C7) and in the levels of breed coverage (Figure 3C1). Breeders' associations exist in most countries, and where they exist are usually involved in conservation programmes. In some countries, *in situ* conservation programmes are in their first stages of development, while in others they are well established. Gene banks in the region usually consist of more than one separate collection managed by different stakeholders. Genetic material from both locally adapted and exotic breeds is usually stored, and collections are typically used both to support in ongoing breeding programmes and for long-term conservation. Gene banks are common in South America, but very scarce in Central America and the Caribbean. *Ex situ in vivo* conservation is relatively well-developed in the region.

In the small island countries of the Southwest Pacific, *in situ* conservation programmes, if exist at all, are in their early stages of development and focus mainly on pigs and chickens (Tables 3C2 and 3C3). The main activities undertaken within these programmes are awareness raising, promotion of niche marketing and breed-related cultural activities. In the case of pigs, there are some community-based conservation programmes. In Australia[11] and New Zealand, most *in situ* conservation activities are implemented by private institutions, with NGOs playing a key role. Despite the lack of government involvement, these programmes include a diverse range of elements. In New Zealand, the Rare Breeds Conservation Society of New Zealand implements all *in situ* conservation activities. It gives small grants to livestock keepers who raise at-risk breeds, manages herd books, distributes newsletters and organizes fairs, shows and field days for awareness raising and educational purposes (country report New Zealand).

Gene banks are present only in Australia and New Zealand. In both countries, these are operated by private bodies rather than by the public sector. In New Zealand, the Rare Breeds Conservation Society of New Zealand maintains a genetic repository in collaboration with a private cryostorage facility, at which genetic material from at-risk breeds is stored in the form of semen and embryos. The gene bank operates entirely on the basis of private funding (country report New Zealand). No information was provided in the country report about the number of breeds from which material is stored. A similar approach is taken in Australia, where breeding organizations and civil societies support *ex situ*

[11] Australia did not provide a country report as part of the second SoW-AnGR reporting process. However, it published a report as an independent initiative in 2012.

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conservation. *In vitro* programmes in this country only include at-risk breeds with commercial potential. There are no gene banks in the small island countries of the region.

In the United States of America, *in situ* conservation is largely undertaken by breeders' associations and other non-governmental bodies. The most widespread activities include awareness raising, the promotion of niche market products, recognition/award programmes for livestock keepers and breeding programmes to improve productivity. Government activity is largely confined to *ex situ in vitro* conservation. The country has a well-developed gene bank that includes genetic material from more than 150 breeds; 30 percent of the country's breeds have enough material stored to allow them to be reconstituted if needed (Table 3C10). The primary role of the programme is to serve as a backup of *in situ* livestock populations that can be drawn upon if a national or industry need arises. However, the collection is also used to provide samples for use in genetic research, to reconstitute research populations, to add genetic variability to industry populations and to evaluate germplasm in a range of different physiological experiments (country report United States of America).

In the Near and Middle East, *in situ* conservation programmes are in early stages of development in most countries. Oman has put in place a well-developed strategic plan for the conservation of dromedary, cattle, sheep, goat and chicken genetic resources. Initial efforts are focused on the identification of at-risk breeds, raising awareness among livestock keepers and children about the state of the country's AnGR and increasing the skills and knowledge of livestock keepers and government officers. In the context of this plan, several international agreements to encourage the conservation and sustainable use of AnGR have been signed and four research centres or stations have been created in the country with the aim of conserving local breeds (country report Oman). Oman is also the only country in the region that reports a gene bank (semen and isolated DNA of two multipurpose cattle breeds is stored and is used for both conservation and breeding purposes).

7. Changes since 2007

Because the sample of countries that provide reports for the second SoW-AnGR is different from the sample from which data were analysed in the first SoW-AnGR, it is difficult to present a direct comparison of the state of capacity in 2014 to that in existence at the time the first SoW-AnGR was prepared. However, in addition to the detailed questions about the current state of conservation measures, the country report questionnaire included some questions about the state of implementation of Strategic Priority Area 3 ("Conservation") of the Global Plan of Action for Animal Genetic Resources (FAO, 2007b). Figure 3C5 summarizes the responses to a question about the state of conservation policies and programmes and whether they have been strengthened since 2007. The figure shows that a substantial number of countries report that they have improved the state of their conservation programmes since 2007. Improvements are more common in Asia and Europe and the Caucasus than in other regions. There are, however, a large number of countries (more than half) that report that they have no policies or programmes or that they have some provisions in place but have made no improvements since 2007. Note that some countries appear to have interpreted this question more conservatively than the question about the various categories of conservation programme (Table 3C1). It is possible that some of these countries have some conservation measures in place but that they do not form part of an organized policy or programme.

In response to a question about obstacles to the improvement of conservation measures, the main reported problem is a lack of financial resources. Other frequently mentioned obstacles include lack of skilled personnel, lack of technical capacity, lack of information on animal genetic resources, lack of national policies and legal frameworks, and insufficient coordination among stakeholders.

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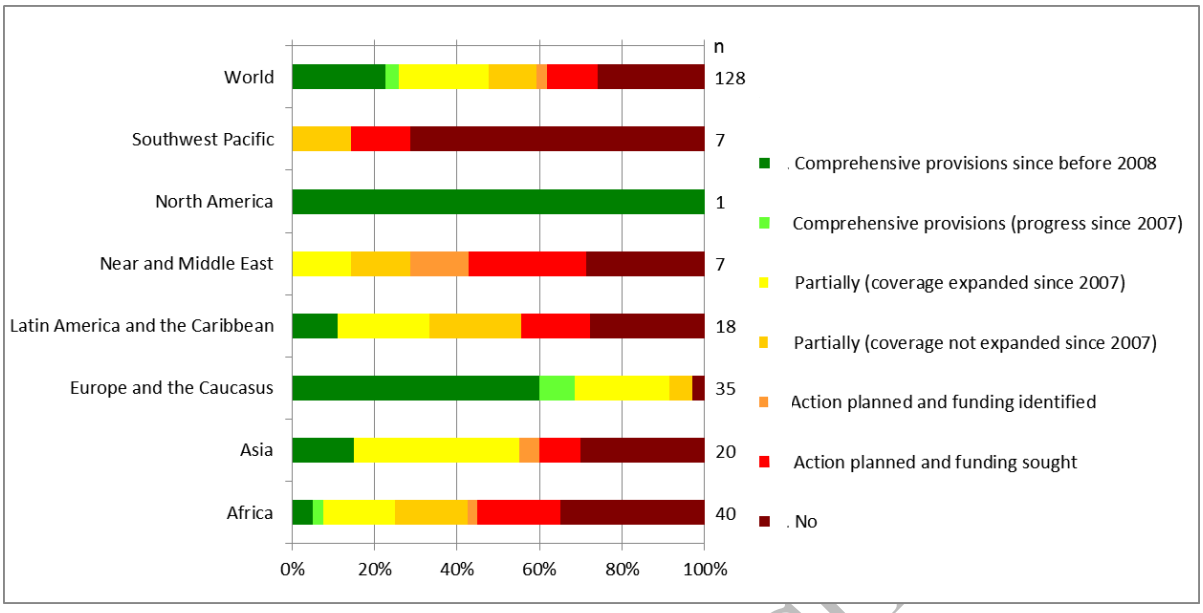
Figure 3C5. Overview of the state of conservation programmes and policies at country level and progress since 2007



Notes: Question was worded as follows: "Does your country have conservation policies and programmes in place to protect locally adapted breeds at risk in all important livestock species?".

8. Conclusions and priorities

Conservation programmes are more widespread than they were at the time the first SoW-AnGR was prepared. Only a minority of countries now report that they have no conservation activities. In terms of practical impacts, the country reports provide several examples of breeds formerly classified as at risk of extinction whose population sizes have increased as a result of successful conservation programmes (e.g. Box 3C3). There are nonetheless major gaps in the breed coverage of conservation programmes, particularly in developing regions and many countries report that they have made little or no progress in improving their conservation measures in recent years.

A wide range of different *in situ* conservation activities are reported. However, many are much more widely used in Europe and the Caucasus, and in some cases North America and in other regions, than elsewhere in the world. While not all activities are relevant in all countries, there appears to be considerable scope for diversifying existing *in situ* conservation programmes. A number of these potential activities are, however, relatively complex to organize and/or require substantial funding. Reported constraints to the improvement of conservation programmes indicate that many countries need to strengthen the basic human and institutional capacities needed for effective AnGR management: knowledge, skills, awareness, technical resources, coherent policies, communication and collaboration among stakeholders, the existence of breeders' associations and other non-governmental bodies interested in AnGR management, and so on (see Part 3 Section [crossref]). In some countries, however, the technical and organizational prerequisites for successful conservation programmes are in place and the main challenge is to strengthen the political will to act.

The breed coverage of *ex situ in vitro* conservation programmes remains very limited overall, and many countries have no gene banks in place. Lack of funding and lack of technical skills are again constraints. However, many countries report that they have plans to establish gene banks. Collaboration at regional or subregional level is a potential means of avoiding duplication in the use of resources, provided the relevant institutional and legal arrangements can be put in place. Interest in initiatives of this kind is reported from several subregions. Country-report responses related to the organization and operation of gene banks suggest that in many cases more could be done in terms of the practical utilization of gene bank material to increase genetic variability within *ex situ* or *in situ* livestock populations. The involvement of breeders' associations and other livestock-sector

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stakeholders in the development and operation of gene banks is another area that may need strengthening.

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Annex1. Uses of the different elements of *in-situ* conservation programmes for the main livestock species

Table A3C1. Proportion of countries reporting the use of each element of *in situ* conservation for dairy cattle

Dairy cattle		Increase demand of breed products and services				Incentivazation and support of livestock keepers				Breeding programmes		Community-level paticipation and empowerment	
Regions and subregions	Number of countries	Promotion of niche marketing	Promotion as tourist attractions	Use as management of widlife habitats and landscape	Promotion of breed-related cultural activities	Incentives for keeping at-risk breeds	Recognition and/or awards	Extension to improve the management of at-risk breeds	Awareness-raising activities	Conservation breeding	Selection for at-risk breeds	Community-based conservation	Biocultural community protocols
		(%)											
Africa	12	50	0	0	17	17	50	42	33	33	17	42	8
East Africa	4	50	0	0	25	25	50	25	25	25	25	25	0
North & West Africa	6	50	0	0	0	17	33	50	33	33	17	33	17
Southern Africa	2	50	0	0	50	0	100	50	50	50	0	100	0
Asia	12	83	0	0	17	17	58	17	25	42	25	58	17
Central Asia	4	75	0	0	25	25	25	25	25	50	25	75	0
East Asia	1	0	0	0	0	0	100	0	0	100	0	0	0
South Asia	3	100	0	0	0	0	100	33	33	67	33	33	33
Southeast Asia	4	100	0	0	25	25	50	0	25	0	25	75	25
Southwest Pacific	3	67	0	0	0	33	33	33	67	0	0	33	0
Europe & the Caucasus	18	83	78	50	67	89	67	72	78	94	67	56	11
Latin America & the Caribbean	8	88	25	25	38	13	50	38	63	100	75	25	25
Caribbean	4	50	0	0	25	0	0	25	50	50	50	0	0
Central America	1	100	100	100	100	0	100	100	100	100	100	100	100
South America	3	33	33	33	33	33	67	33	67	100	100	33	33
North America	1	100	0	0	0	0	100	0	100	0	100	0	0
Near & Middle East	3	67	0	0	0	0	0	0	0	33	0	33	0
World	57	75	28	19	33	39	54	42	51	61	42	46	12

Note: The figures shown in the table correspond to the number of countries reporting the respective activity in dairy cattle conservation divided by the total number of countries reporting the presence of in situ conservation programmes for dairy cattle,

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Table A3C2. Proportion of countries reporting the use of each element of *in situ* conservation for beef cattle

Beef cattle		Increase demand of breed products and services				Incentivazation and support of livestock keepers				Breeding programmes		Community-level paticipation and empowerment	
Regions and subregions	*Number of countries	Promotion of niche marketing	Promotion as tourist attractions	Use as management of widlife habitats and landscape	Promotion of breed-related cultural activities	Incentives for keeping at-risk breeds	Recognition and/or awards	Extension to improve the management of at-risk breeds	Awareness-raising activities	Conservation breeding	Selection for at-risk breeds	Community-based conservation	Biocultural community protocols
		(%)											
Africa	17	47	18	12	35	12	29	35	53	71	47	35	12
East Africa	4	50	25	0	50	25	25	25	25	25	50	0	0
North & West Africa	7	43	0	0	14	14	29	43	29	71	14	57	14
Southern Africa	6	50	33	33	50	0	33	33	100	100	83	33	17
Asia	11	55	18	9	18	36	36	36	55	82	45	55	36
Central Asia	4	25	0	0	0	25	0	25	25	50	0	0	0
East Asia	2	100	0	0	0	100	50	50	50	100	0	100	50
South Asia	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Southeast Asia	5	60	40	20	40	20	60	40	80	100	80	80	60
Southwest Pacific	3	100	0	0	0	33	33	67	67	33	33	33	0
Europe & the Caucasus	16	94	75	75	81	75	75	75	88	88	69	56	19
Latin America & the Caribbean	11	73	36	18	45	9	45	36	45	82	45	27	18
Caribbean	3	33	33	0	33	0	67	33	33	33	33	0	0
Central America	2	100	50	50	50	0	50	50	50	50	50	50	50
South America	6	50	33	17	50	17	33	33	50	100	50	33	17
North America	1	100	100	0	0	0	100	0	100	0	100	0	0
Near & Middle East	1	0	0	0	0	0	0	0	0	0	0	0	0
World	60	68	37	28	43	33	47	47	62	75	52	42	18

Note: The figures shown in the table correspond to the number of countries reporting the respective activity in beef cattle conservation divided by the total number of countries reporting the presence of in situ conservation programmes for beef cattle.

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Table A3C3. Proportion of countries reporting the use of each element of *in situ* conservation for multipurpose cattle

Multipurpose cattle		Increase demand of breed products and services				Incentivazation and support of livestock keepers				Breeding programmes		Community-level paticipation and empowerment	
Regions and subregions	Number of countries	Promotion of niche marketing	Promotion as tourist attractions	Use as management of wildlife habitats and landscape	Promotion of breed-related cultural activities	Incentives for keeping at-risk breeds	Recognition and/or awards	Extension to improve the management of at-risk breeds	Awareness-raising activities	Conservation breeding	Selection for at-risk breeds	Community-based conservation	Biocultural community protocols
		(%)											
Africa	17	35	12	6	29	12	29	47	47	76	53	47	18
East Africa	6	33	17	0	50	0	17	33	33	50	33	33	33
North & West Africa	9	44	11	11	22	22	33	44	56	100	67	56	11
Southern Africa	2	0	0	0	0	0	50	100	50	50	50	50	0
Asia	10	60	40	20	40	30	50	50	70	90	60	80	30
Central Asia	3	67	0	0	0	0	33	0	0	33	33	67	0
East Asia	1	100	100	100	100	100	100	100	100	100	100	100	100
South Asia	5	40	40	0	20	40	60	60	80	100	60	80	20
Southeast Asia	1	100	100	100	100	0	0	100	100	100	100	100	100
Southwest Pacific	3	67	0	0	33	33	33	33	67	0	0	33	0
Europe & the Caucasus	27	59	59	56	59	89	56	78	78	85	56	37	11
Latin America & the Caribbean	7	71	29	29	29	14	29	29	57	71	71	43	29
Caribbean	4	25	0	0	0	0	0	0	50	25	25	0	0
Central America	1	100	100	100	100	0	100	100	100	100	100	100	100
South America	2	50	50	50	50	50	50	50	50	100	100	50	50
North America	1	100	100	0	0	0	100	0	100	100	100	0	0
Near & Middle East	2	100	0	0	100	0	50	50	50	100	50	100	0
World	67	57	37	30	45	46	45	57	66	79	55	48	16

Note: The figures shown in the table correspond to the number of countries reporting the respective activity in the cattle conservation of multipurpose cattle divided by the total number of countries reporting the presence of in situ conservation programmes for multipurpose cattle,.

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Table A3C4. Proportion of countries reporting the use of each element of *in situ* conservation for sheep

Sheep		Increase demand of breed products and services				Incentivazation and support of livestock keepers				Breeding programmes		Community-level paticipation and empowerment	
Regions and subregions	Number of countries	Promotion of niche marketing	Promotion as tourist attractions	Use as management of wildlife habitats and landscape	Promotion of breed-related cultural activities	Incentives for keeping at-risk breeds	Recognition and/or awards	Extension to improve the management of at-risk breeds	Awareness-raising activities	Conservation breeding	Selection for at-risk breeds	Community-based conservation	Biocultural community protocols
		(%)											
Africa	18	39	6	6	28	11	28	44	44	72	44	44	22
East Africa	3	33	0	0	33	0	0	0	0	0	33	100	33
North & West Africa	10	30	10	10	40	20	40	50	50	80	50	40	20
Southern Africa	5	60	0	0	0	0	20	60	60	100	40	20	20
Asia	15	67	27	13	27	33	40	47	67	60	33	60	13
Central Asia	4	50	0	0	25	25	25	25	25	50	25	50	0
East Asia	2	50	50	50	50	50	50	50	100	50	50	50	50
South Asia	4	75	50	0	25	50	50	100	100	100	75	100	0
Southeast Asia	5	80	20	20	20	20	40	20	60	40	0	40	20
Southwest Pacific	2	100	0	0	0	50	100	100	100	100	100	100	0
Europe & the Caucasus	32	75	75	63	75	94	59	84	88	91	75	53	19
Latin America & the Caribbean	13	69	23	15	23	8	46	54	54	69	54	46	23
Caribbean	4	75	50	0	0	0	50	50	75	75	75	25	25
Central America	3	67	0	33	33	0	33	33	33	33	33	67	33
South America	6	67	17	17	33	17	50	67	50	83	50	50	17
North America	1	100	100	0	100	0	100	100	100	100	100	100	0
Near & Middle East	5	40	20	20	40	20	40	60	60	80	40	60	20
World	86	64	40	30	45	47	48	64	69	78	57	53	19

Note: The figures shown in the table correspond to the number of countries reporting the respective activity in sheep conservation divided by the total number of countries reporting the presence of in situ conservation programmes for sheep.

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Table A3C5. Proportion of countries reporting the use of each element of *in situ* conservation for goats

Goats		Increase demand of breed products and services				Incentivazation and support of livestock keepers				Breeding programmes		Community-level paticipation and empowerment	
Regions and subregions	Number of countries	Promotion of niche marketing	Promotion as tourist attractions	Use as management of widlife habitats and landscape	Promotion of breed-related cultural activities	Incentives for keeping at-risk breeds	Recognition and/or awards	Extension to improve the management of at-risk breeds	Awareness-raising activities	Conservation breeding	Selection for at-risk breeds	Community-based conservation	Biocultural community protocols
		(%)											
Africa	19	53	0	0	37	11	21	47	53	95	37	47	26
East Africa	4	75	0	0	25	0	0	25	0	50	50	50	25
North & West Africa	9	33	0	0	33	22	33	44	67	100	44	56	33
Southern Africa	6	67	0	0	50	0	17	67	67	117	17	33	17
Asia	13	85	38	15	54	38	46	46	69	69	69	77	23
Central Asia	3	67	0	0	33	33	33	33	33	33	33	67	0
East Asia	3	67	33	33	33	33	33	33	67	33	33	33	33
South Asia	2	100	100	0	100	100	100	100	100	100	100	100	50
Southeast Asia	5	80	40	20	60	20	40	20	60	60	60	80	20
Southwest Pacific	2	100	0	0	0	0	0	50	50	50	50	50	50
Europe & the Caucasus	29	79	69	59	66	90	55	76	86	83	62	45	14
Latin America & the Caribbean	10	70	30	20	30	10	50	40	40	70	50	40	20
Caribbean	4	75	25	0	25	0	50	25	50	75	75	25	0
Central America	3	67	33	33	33	0	33	33	33	33	33	33	33
South America	3	67	33	33	33	33	67	67	33	100	33	67	33
North America	1	100	0	0	0	0	100	100	100	0	100	0	0
Near & Middle East	5	40	20	20	60	20	40	60	40	80	40	40	20
World	79	72	37	28	49	44	43	58	66	80	54	49	20

Note: The figures shown in the table correspond to the number of countries reporting the respective activity in goat conservation divided by the total number of countries reporting the presence of in situ conservation programmes for goats.

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Table A3C6. Proportion of countries reporting the use of each element of *in situ* conservation for pigs

Pigs		Increase demand of breed products and services				Incentivazation and support of livestock keepers				Breeding programmes		Community-level paticipation and empowerment	
Regions and subregions	Number of countries	Promotion of niche marketing	Promotion as tourist attractions	Use as management of widlife habitats and landscape	Promotion of breed-related cultural activities	Incentives for keeping at-risk breeds	Recognition and/or awards	Extension to improve the management of at-risk breeds	Awareness-raising activities	Conservation breeding	Selection for at-risk breeds	Community-based conservation	Biocultural community protocols
		(%)											
Africa	12	25	8	0	17	17	25	33	42	67	25	25	8
East Africa	3	0	0	0	0	0	0	0	0	0	33	0	0
North & West Africa	6	17	0	0	33	33	33	50	50	83	33	33	17
Southern Africa	3	67	33	0	0	0	33	33	67	100	0	33	0
Asia	10	100	50	30	50	50	50	60	80	90	70	100	20
Central Asia	1	0	0	0	0	0	0	0	0	0	0	0	0
East Asia	3	100	33	33	33	67	33	33	67	100	67	100	33
South Asia	3	100	67	0	33	67	67	100	100	100	100	100	0
Southeast Asia	3	100	67	67	100	33	67	33	67	67	67	100	33
Southwest Pacific	5	60	0	20	60	20	20	80	80	20	20	80	0
Europe & the Caucasus	25	84	52	28	64	84	56	64	76	96	68	48	20
Latin America & the Caribbean	11	73	27	27	27	9	18	27	36	64	45	36	18
Caribbean	4	75	25	0	0	0	0	0	25	50	25	25	0
Central America	3	100	33	33	33	0	33	33	33	67	67	67	33
South America	4	50	25	50	50	25	25	50	50	75	50	25	25
North America	1	100	0	0	0	0	100	100	100	0	100	100	0
Near & Middle East	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
World	64	72	34	22	45	47	41	53	66	77	53	53	16

Note: The figures shown in the table correspond to the number of countries reporting the respective activity in pig conservation divided by the total number of countries reporting the presence of in situ conservation programmes for pigs.

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Table A3C7. Proportion of countries reporting the use of each element of *in situ* conservation for chickens

Chickens		Increase demand of breed products and services				Incentivazation and support of livestock keepers				Breeding programmes		Community-level paticipation and empowerment	
Regions and subregions	Number of countries	Promotion of niche marketing	Promotion as tourist attractions	Use as management of wildlife habitats and landscape	Promotion of breed-related cultural activities	Incentives for keeping at-risk breeds	Recognition and/or awards	Extension to improve the management of at-risk breeds	Awareness-raising activities	Conservation breeding	Selection for at-risk breeds	Community-based conservation	Biocultural community protocols
		(%)											
Africa	16	50	0	6	13	13	25	38	31	56	13	44	25
East Africa	3	67	0	33	0	33	0	33	0	0	0	33	33
North & West Africa	8	25	0	0	25	13	38	38	38	50	25	25	13
Southern Africa	5	80	0	0	0	0	20	40	40	100	0	80	40
Asia	14	79	57	21	57	43	50	43	71	86	71	93	29
Central Asia	3	67	0	0	33	33	0	33	33	33	0	33	0
East Asia	3	100	67	33	67	100	67	33	67	67	67	100	67
South Asia	4	50	50	0	25	25	50	75	100	100	100	100	0
Southeast Asia	4	100	100	50	100	25	75	25	75	100	100	100	50
Southwest Pacific	5	40	20	0	40	20	20	60	40	20	0	40	0
Europe & the Caucasus	23	74	57	13	70	65	48	70	87	74	61	35	17
Latin America & the Caribbean	8	75	13	25	25	25	25	38	38	50	38	25	25
Caribbean	3	67	0	0	0	33	0	0	33	33	0	0	0
Central America	2	100	0	50	50	0	50	50	50	50	50	50	50
South America	3	67	33	33	33	33	33	67	33	67	67	33	33
North America	1	100	0	0	0	0	100	0	100	100	100	0	0
Near & Middle East	3	33	0	0	0	0	33	33	33	67	33	0	0
World	70	66	33	13	43	37	39	50	60	66	44	46	20

Note: The figures shown in the table correspond to the number of countries reporting the respective activity in chicken conservation divided by the total number of countries reporting the presence of in situ conservation programmes for chickens.

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Annex 2. Characteristics and functions of national gene banks – species breakdown

Table A3C8. Characteristics and functions of national gene banks – dairy cattle

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in *ex situ* population	Increase genetic variability in *in situ* population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	44	33	44	44	0
East Africa	3	33	33	33	33	0
North & West Africa	3	67	67	67	67	0
Southern Africa	3	33	0	33	33	0
Asia	**12**	92	33	42	50	0
Central Asia	2	100	100	100	100	0
East Asia	4	75	0	0	25	0
South Asia	2	100	0	0	0	0
Southeast Asia	4	100	25	50	50	0
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	76	68	20	40	4
Latin America & the Caribbean	**8**	63	25	0	13	0
Caribbean	2	100	0	0	0	0
Central America	1	100	100	0	0	0
South America	5	20	20	0	20	0
North America	**1**	100	100	100	100	0
Near & Middle East	**1**	0	0	0	0	0
World	**57**	70	47	26	39	2

Note: The figures represent the proportion of countries (out of the total number reporting the presence of an in vitro gene bank for AnGR) that indicate the presence of the respective activity in dairy cattle conservation.

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Table A3C9. Characteristics and functions of national gene banks – beef cattle

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in *ex situ* population	Increase genetic variability in *in situ* population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	44	33	44	56	0
East Africa	3	33	33	33	33	0
North & West Africa	3	67	67	67	67	0
Southern Africa	3	33	0	33	67	0
Asia	**12**	67	25	33	33	8
Central Asia	2	50	0	50	50	0
East Asia	4	75	0	0	25	0
South Asia	2	0	0	0	0	0
Southeast Asia	4	100	75	75	50	25
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	60	48	8	24	0
Latin America & the Caribbean	**8**	38	50	13	25	0
Caribbean	2	50	0	0	0	0
Central America	1	0	100	0	0	0
South America	5	40	60	20	40	0
North America	**1**	100	100	100	100	0
Near & Middle East	**1**	0	0	0	0	0
World	**57**	54	40	21	32	2

Note: The figures represent the proportion of countries (out of the total number reporting the presence of an in vitro gene bank for AnGR) that indicate the presence of the respective activity in beef cattle conservation.

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Table A3C10. Characteristics and functions of national gene banks – multipurpose cattle

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in *ex situ* population	Increase genetic variability in *in situ* population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	44	33	44	44	0
East Africa	3	33	33	0	33	0
North & West Africa	3	100	67	100	100	0
Southern Africa	3	0	0	33	0	0
Asia	**12**	58	33	42	42	8
Central Asia	2	50	100	100	100	0
East Asia	4	50	25	25	50	25
South Asia	2	100	50	0	50	0
Southeast Asia	4	50	0	50	0	0
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	52	56	12	36	0
Latin America & the Caribbean	**8**	50	25	0	13	0
Caribbean	2	0	0	0	0	0
Central America	1	100	100	0	0	0
South America	5	60	20	0	20	0
North America	**1**	100	100	0	0	0
Near & Middle East	**1**	100	0	0	100	0
World	**57**	53	42	21	35	2

Note: *Note: The figures represent the proportion of countries (out of the total number reporting the presence of an in vitro gene bank for AnGR) that indicate the presence of the respective activity the conservation of multipurpose cattle.*

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Table A3C11. Characteristics and functions of national gene banks – sheep

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in *ex situ* population	Increase genetic variability in *in situ* population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	22	22	11	11	0
East Africa	3	0	0	0	0	0
North & West Africa	3	33	33	33	33	0
Southern Africa	3	33	33	0	0	0
Asia	**12**	83	25	33	25	0
Central Asia	2	100	50	50	100	0
East Asia	4	75	25	25	25	0
South Asia	2	100	50	0	0	0
Southeast Asia	4	75	0	50	0	0
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	64	76	4	12	0
Latin America & the Caribbean	**8**	38	25	0	25	0
Caribbean	2	50	0	0	0	0
Central America	1	0	0	0	0	0
South America	5	40	40	0	40	0
North America	**1**	100	100	100	100	0
Near & Middle East	**1**	0	0	0	0	0
World	**57**	56	47	12	18	0

Note: *The figures represent the proportion of countries (out of the total number reporting the presence of an in vitro gene bank for AnGR) that indicate the presence of the respective activity in sheep conservation.*

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Table A3C12. Characteristics and functions of national gene banks – goats

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in *ex situ* population	Increase genetic variability in *in situ* population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	22	22	22	22	11
East Africa	3	0	0	0	0	0
North & West Africa	3	33	33	33	33	0
Southern Africa	3	33	33	33	33	33
Asia	**12**	75	17	33	25	0
Central Asia	2	100	0	50	50	0
East Asia	4	75	25	25	25	0
South Asia	2	50	0	0	0	0
Southeast Asia	4	75	25	50	25	0
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	52	64	8	12	0
Latin America & the Caribbean	**8**	38	25	0	25	0
Caribbean	2	50	0	0	0	0
Central America	1	0	0	0	0	0
South America	5	40	40	0	40	0
North America	**1**	100	100	100	0	0
Near & Middle East	**1**	0	0	0	0	0
World	**57**	49	40	16	18	2

Note: The figures represent the proportion of countries (out of the total number reporting the presence of an in vitro gene bank for AnGR) that indicate the presence of the respective activity in goat conservation.

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Table A3C13. Characteristics and functions of national gene banks – pigs

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in *ex situ* population	Increase genetic variability in *in situ* population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	33	33	22	22	11
East Africa	3	0	0	0	0	0
North & West Africa	3	67	67	67	67	0
Southern Africa	3	33	33	0	0	33
Asia	**12**	25	25	25	0	8
Central Asia	2	0	0	0	0	0
East Asia	4	25	25	25	0	0
South Asia	2	50	50	0	0	0
Southeast Asia	4	25	25	50	0	25
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	44	52	8	20	0
Latin America & the Caribbean	**8**	13	13	0	13	0
Caribbean	2	0	0	0	0	0
Central America	1	0	0	0	0	0
South America	5	20	20	0	20	0
North America	**1**	100	100	100	100	100
Near & Middle East	**1**	0	0	0	0	0
World	**57**	33	37	14	16	5

Note: The figures represent the proportion of countries (out of the total number reporting the presence of an in vitro gene bank for AnGR) that indicate the presence of the respective activity in pig conservation.

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Table A3C14. Characteristics and functions of national gene banks – chickens

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeder's association	Increase genetic variability in *ex situ* population	Increase genetic variability in *in situ* population	Reconstitution of extinct breeds
		(%)				
Africa	**9**	11	11	11	11	0
East Africa	3	0	0	0	0	0
North & West Africa	3	0	0	0	0	0
Southern Africa	3	33	33	33	33	0
Asia	**12**	25	25	17	8	8
Central Asia	2	0	0	0	0	0
East Asia	4	25	25	25	25	25
South Asia	2	50	50	0	0	0
Southeast Asia	4	25	25	25	0	0
Southwest Pacific	**1**	0	0	0	0	0
Europe & the Caucasus	**25**	8	32	0	4	4
Latin America & the Caribbean	**8**	0	0	0	0	0
Caribbean	2	0	0	0	0	0
Central America	1	0	0	0	0	0
South America	5	0	0	0	0	0
North America	**1**	100	100	0	0	0
Near & Middle East	**1**	0	0	0	0	0
World	**57**	12	23	5	5	4

Note: The figures represent the proportion of countries (out of the total number reporting the presence of an in vitro gene bank for AnGR) that indicate the presence of the respective activity in chicken conservation.

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SECTION D. REPRODUCTIVE AND MOLECULAR BIOTECHNOLOGIES

1. Introduction

This section presents a review and analysis of the use and state of reproductive and molecular biotechnologies based on the information reported in the country reports. The biotechnologies on which countries were requested to provide information are listed in Box 3D1. The section is structured as follows: Subsection 2 presents a global overview of where and to what extent various molecular and reproductive biotechnologies are used in the livestock sector; Subsection 3 discusses stakeholder involvement in the delivery of biotechnology services in the livestock sector; Subsection 4 presents region by region descriptions of the state of use of reproductive and molecular biotechnologies; Subsection 5 discusses changes since the time of the first report on *The State of the World's Animal Genetic Resources for Food and Agriculture* (FAO, 2007) was prepared; and finally Subsection 6 presents some conclusions and future priorities.

Box 3D1. Glossary of biotechnologies

Artificial insemination (AI): The process by which sperm is placed into a female's uterus (intrauterine), or cervix (intracervical) using artificial means and with the intention of impregnating the female, rather than by natural mating.

Embryo transfer: A step in the process of assisted reproduction in which embryos are placed into the uterus of a female with the intent of establishing a pregnancy.

Multiple ovulation and embryo transfer (MOET): A technology by which a single female that usually produces only one or two offspring can produce a litter of offspring. It involves the stimulation of a female to shed large numbers of ova, natural mating or artificial insemination, collection of fertilized ova (either surgically, or non-surgically though the cervix), and transfer (usually non-surgically through the cervix) of these fertilized ova to recipient females.

Semen sexing: The separation of mammalian sperm into those bearing an X chromosome and those bearing a Y chromosome, in order to be able to produce, via artificial insemination or *in vitro* fertilization, animals of a specified sex.

***In vitro* fertilization**: The process whereby an egg is fertilized with sperm outside the body of the animal before being re-implanted into the uterus.

Cloning: The process of creating genetically identical organisms by nuclear transplantation.

Genetic modification: The direct manipulation of an organism's genome using biotechnology.

Molecular genetic or genomic information: Information contained in a nucleotide base sequence in chromosomal DNA or RNA, which may be used to estimate breeding values, in the selection of progeny, to detect carriers of diseases or for marker assisted introgression of genes.

Transplantation of gonadal tissues: Ovarian tissue harvested from immature female chicks, frozen, thawed and transferred back to other young females. Newly hatched chick testicular tissue harvested and transplanted successfully to host chicks, resulting in live offspring born from sperm derived from the donor testicular tissue. For further information see: FAO. 2012. *Cryoconservation of animal genetic resources*. FAO Animal Production and Health Guidelines No. 12. Rome. (available at: http://www.fao.org/docrep/016/i3017e/i3017e00.htm).

2. Global overview of the level of use of reproductive and molecular technologies in livestock production

In the country-report questionnaire, countries were requested to indicate the level of availability of a range of reproductive and molecular technologies by providing a score (by species): none; low (at experimental level only); medium (available to livestock keepers in some locations or production systems); or high (widely available to livestock keepers). Responding to the question was optional. Countries could provide information on any of the livestock species covered in the questionnaire.[1] The responses are summarized in Tables 3D1 and 3D2.

Table 3D1. Use of reproductive and molecular biotechnologies – regional breakdown

Regions and subregions	Number of countries	Artificial insemination	Embryo transfer	Molecular genetic or genomic information	Multiple ovulation and embryo transfer
		(%)			
Africa	**38**	**87**	**32**	**24**	**18**
East Africa	7	100	71	29	43
North & West Africa	19	74	16	21	11
Southern Africa	12	100	33	25	17
Asia	**16**	**100**	**94**	**81**	**81**
Central Asia	3	100	100	33	100
East Asia	3	100	100	67	100
South Asia	5	100	80	60	40
Southeast Asia	5	100	100	100	100
Southwest Pacific	**7**	**57**	**29**	**29**	**29**
Europe & the Caucasus	**35**	**100**	**89**	**80**	**69**
Latin America & the Caribbean	**17**	**100**	**82**	**59**	**76**
Caribbean	5	100	40	0	20
Central America	4	100	100	75	100
South America	8	100	100	88	100
North America	**1**	**100**	**100**	**100**	**100**
Near & Middle East	**6**	**100**	**33**	**50**	**17**
World	**120**	**93**	**64**	**55**	**51**

Note: The figures indicate the proportion of responding countries that reported the use of the respective technology at least at experimental level.

AI is the most widely used biotechnology, with 93 percent of reporting countries indicating that it is used at least to some extent. The only regions/subregions where this biotechnology is not reported to be used in all countries are the Southwest Pacific and North and West Africa. Embryo transfer is less widely reported, but is nonetheless used to some extent in a majority of countries. Countries that do not report the use of embryo transfer are more common in Africa, the Near and Middle East and the Southwest Pacific than in other regions. The use of semen sexing and *in vitro* fertilization is less commonly reported. Apart from North America (represented only by the United States of America), where all the technologies under consideration are used at least at experimental level, these two technologies are reported with medium frequency in Asia, Europe and the Caucasus, and Latin America and the Caribbean, and rarely in other regions. Few countries report the use of cloning, genetic modification or the transplantation of gonadal tissue. The use of molecular genetic or genomic information is reported with medium frequency overall, least frequently in Africa, the Southwest Pacific and Central Asia.

[1] The questionnaire (see http://www.fao.org/Ag/AGAInfo/programmes/en/genetics/Second_state.html) allowed for answers on the following species: alpaca, ass, Bactrian camel, buffalo, cattle, chicken, dromedary, duck, goat, goose, guinea pig, guinea fowl, horse, llama, Muscovy duck, ostrich, pig, pigeon, quail, rabbit, sheep, turkey, yak.

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Table 3D2. Use of advanced reproductive and molecular biotechnologies – regional breakdown

Regions and subregions	Number of countries	Semen sexing	In vitro fertilization	Cloning	Genetic modification	Transplantation of gonadal tissue
		(%)				
Africa	**38**	**16**	**5**	**3**	**0**	**0**
East Africa	7	57	14	0	0	0
North & West Africa	19	5	5	0	0	0
Southern Africa	12	8	0	8	0	0
Asia	**16**	**63**	**75**	**56**	**44**	**25**
Central Asia	3	100	33	33	33	33
East Asia	3	67	100	67	67	33
South Asia	5	20	20	20	20	0
Southeast Asia	5	80	100	60	20	0
Southwest Pacific	**7**	**14**	**14**	**14**	**14**	**14**
Europe & the Caucasus	**35**	**60**	**54**	**20**	**11**	**14**
Latin America & the Caribbean	**17**	**47**	**65**	**24**	**24**	**6**
Caribbean	5	0	0	0	20	0
Central America	4	100	100	0	0	0
South America	8	50	88	50	38	13
North America	**1**	**100**	**100**	**100**	**100**	**100**
Near & Middle East	**6**	**17**	**17**	**0**	**0**	**0**
World	**120**	**40**	**39**	**19**	**14**	**10**

Note: The figures indicate the proportion of responding countries that reported the use of the respective technology at least at experimental level.

The figures shown in Tables 3D1 and 3D2 conceal big differences in the level of availability of the various technologies and in the extent of their use in different species and different production systems. Tables 3D3 and 3D4 present a species breakdown of the reported use of the technologies and of the scores for their availability (see above). Figure 3D1 shows the frequency distribution of the availability scores by region.

Table 3D3. Level of availability of reproductive and molecular technologies for use in livestock production – "big five" species

Technology	Dairy cattle		Beef cattle		Multi-purpose cattle		Sheep		Goats		Pigs		Chickens	
	n	Score	n	Score	n	Score	n	Score	n	Score	n	Score	n	Score
Artificial insemination	98	2.5	70	2.1	65	2.2	56	1.6	54	1.4	63	2.2	33	1.4
Embryo transfer	70	1.6	49	1.7	38	1.6	32	1.4	25	1.2	19	1.5	3	1.0
Molecular genetic or genomic information	52	1.8	37	1.6	35	1.5	35	1.6	33	1.4	28	1.8	25	1.5
Multiple ovulation and embryo transfer	54	1.6	36	1.7	22	1.6	29	1.3	26	1.2	16	0.0	3	1.0
Semen sexing	46	1.8	29	1.8	21	1.7	7	1.3	6	1.0	11	1.2	5	1.0
In vitro fertilization	39	1.3	31	1.3	17	1.2	16	0.0	15	1.1	11	1.0	6	1.0
Cloning	14	1.4	12	1.4	6	1.0	11	1.0	10	1.0	7	1.0	4	1.0
Genetic modification	10	1.1	10	1.1	4	1.0	5	1.0	8	1.1	8	1.0	6	1.0
Transplantation of gonadal tissue	6	1.0	5	1.0	2	1.0	4	1.0	3	1.0	4	1.0	6	1.2

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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Table 3D4. Use of reproductive and molecular technologies – selected "minor" species

		Buffaloes	Horses	Asses	Dromedaries	Rabbits	Ducks	Turkeys	Geese	Guinea fowls
Number of countries reporting presence of species		31	62	30	14	43	43	31	28	20
Artificial insemination	%	58	63	10	14	19	9	16	11	10
Embryo transfer		29	34	7	14	5	2	3	4	0
Molecular genetic or genomic information		26	29	13	21	9	7	10	11	10
Multiple ovulation and embryo transfer		26	21	3	14	5	2	3	4	0
Semen sexing		6	10	3	0	0	2	3	4	0
In vitro fertilization		19	15	10	14	2	2	3	4	0
Cloning		10	10	3	0	2	2	3	4	0
Genetic modification		3	3	3	7	2	5	10	7	5
Transplantation of gonadal tissue		3	3	7	0	0	2	6	4	0

As well as being the most widely reported biotechnology, AI also has the highest average scores for availability to livestock keepers in the countries where it is used (Table 3D1 and 3D3). More than 40 percent of all reporting countries indicate that AI is widely available to livestock keepers raising dairy cattle (Figure 3D1). However, the figure is much lower for beef and multipurpose cattle and pigs (less than 25 percent) and very low for other species.[2] Across all the other reproductive technologies considered, high levels and medium levels of availability are more commonly reported in cattle than in any other species and more commonly among dairy cattle than beef and multipurpose cattle. In the case of the use of molecular genetic or genomic information, high and medium scores are again most frequent for dairy cattle. However, they are relatively frequent also in sheep and pigs (roughly at the same level as beef and multipurpose cattle). For all technologies apart from AI, high and medium scores are a small minority of responses, indicating that in most countries they are used, if at all, only on an experimental basis.

In order to obtain an indication of differences between production systems in the level of use of AI and of the sources of the semen used, countries were asked to indicate (by providing a score) the relative contributions of natural mating, artificial insemination using semen from locally adapted breeds, artificial insemination using nationally produced semen from exotic breeds and artificial insemination using imported semen to the total number of matings/inseminations within the various production systems present in the country. The production system categories used in the questionnaire are shown in Box 3D2. The responses are summarized in Table 3D5.

Box 3D2. Glossary of production systems

Ranching or similar grassland-based production systems: Systems in which animals are grazed on privately owned grassland and/or fed largely on feed obtained from grassland.

Pastoralists systems: Systems in which the livestock keepers move with their herds or flocks in an opportunistic way on communal land to find feed and water for their animals (either from or not from a fixed home base).

Mixed farming systems (rural areas): Systems in which livestock keeping is integrated with other agricultural activities, together forming a whole. Mixed systems (rural areas): mixed systems that do not fall in the category "small-scale urban or peri-urban".

Industrial systems: Large-scale landless production systems in which the production environment is highly controlled by management interventions. Landless systems are those in which livestock production is separated from the land where the feed given to the animals is produced.

Small-scale peri-urban systems: Small-scale (as judged by nationally relevant criteria) systems situated in or close to a city or large town from which products are supplied to the markets of the respective city or large town; these systems may be "landless" (backyard or scavenger) or, in peri-urban areas, may involve mixed farming.

[2] It is possible that these figures are underestimates given that some countries did not provide responses to the respective question. However, it seems likely that most countries with high levels of provision to report would have done so.

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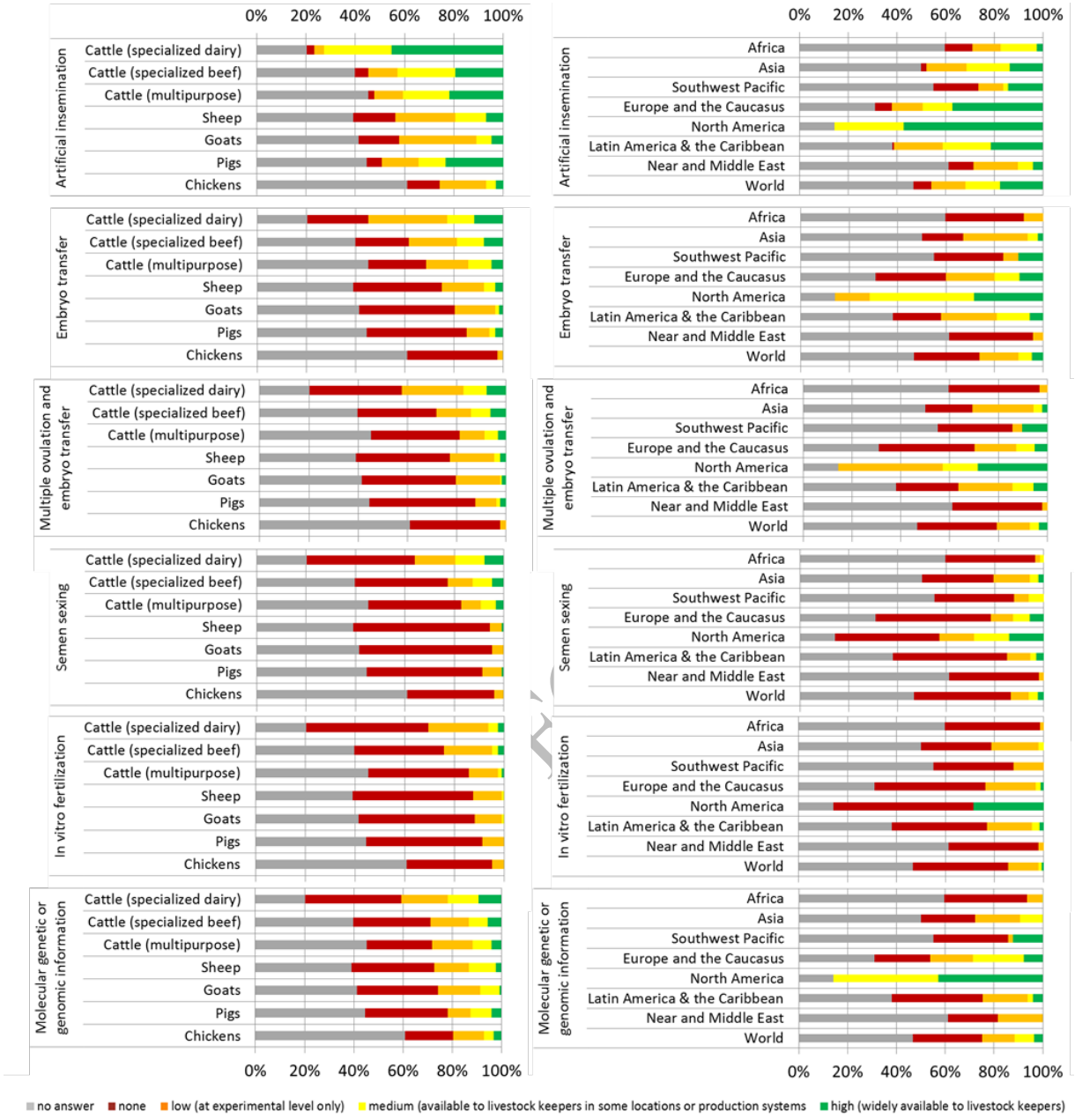
Figure 3D1. Level of availability of reproductive technologies – regional and species ("big five") breakdowns showing frequency of responses



Notes: The bar charts show the proportion of responses falling into the none, low, medium and high categories of breed coverage (see legend). The charts on the left show the overall proportion of countries that provided the respective response for the respective species. The charts on the right, show the proportion of answers (country × species combinations) from the respective region falling into the respective category.

Table 3D5. Level of use of artificial insemination and sources of semen – production system and species ("big five') breakdowns

Species	Production system	Imported semen from exotic breeds	Nationally produced semen from exotic breeds	Semen from locally adapted breeds	Natural mating
		score			
Dairy cattle	Pastoralist	0.5	0.5	0.4	2.0
	Ranching	1.1	0.7	0.7	1.9
	Mixed farming	1.2	0.9	0.9	1.8
	Small-scale (peri)urban	1.2	0.7	0.6	1.4
	Industrial	1.6	1.0	0.8	0.9
Beef cattle	Pastoralist	0.4	0.4	0.4	2.2
	Ranching	0.9	0.6	0.5	2.4
	Mixed farming	0.8	0.6	0.7	2.3
	Small-scale (peri)urban	0.7	0.4	0.5	2.0
	Industrial	1.0	0.7	0.7	1.3
Multipurpose cattle	Pastoralist	0.4	0.4	0.4	2.3
	Ranching	0.8	0.6	0.8	2.2
	Mixed farming	1.0	0.6	1.0	2.2
	Small-scale (peri)urban	1.0	0.6	0.7	1.7
	Industrial	1.0	0.8	0.8	1.0
Sheep	Pastoralist	0.1	0.2	0.2	2.4
	Ranching	0.2	0.3	0.3	2.6
	Mixed farming	0.3	0.3	0.4	2.7
	Small-scale (peri)urban	0.2	0.2	0.3	2.3
	Industrial	0.2	0.4	0.4	1.9
Goats	Pastoralist	0.1	0.1	0.2	2.4
	Ranching	0.2	0.2	0.2	2.4
	Mixed farming	0.2	0.3	0.4	2.7
	Small-scale (peri)urban	0.2	0.2	0.2	2.4
	Industrial	0.2	0.3	0.4	1.7
Pigs	Pastoralist	0.3	0.1	0.1	2.0
	Ranching	0.3	0.2	0.2	1.8
	Mixed farming	0.6	0.7	0.6	2.3
	Small-scale (peri)urban	0.4	0.5	0.3	2.3
	Industrial	0.9	1.2	0.9	1.4

Note: The figures represent average scores for the extent to which artificial insemination and natural mating is used in the respective species in the respective production system. The following scoring system was used: none (0); low – approximately <33% of matings – (1); medium – approximately 33–66% of matings – (2); high – approximately >67% of matings – (3); or "production system not present in this country". Countries where a given species × production system combinations does not exist were excluded from the calculation of the respective average score.

The only species × production system combinations for which natural mating received an average score of less than 2 (approximately 33–66 percent of matings) were industrial systems (all species), dairy cattle (all systems except pastoralist), multipurpose cattle in small-scale peri-urban or urban systems and pigs in "ranching" systems (these are presumably pigs raised in outdoor systems that are not part of mixed farms). The averages conceal the extent of variation between regions and between countries within regions. Moreover, given the broad range of coverage represented by each category, the scores do not provide very precise estimates of the level of AI use. However, it appears that apart from the dairy sector and "industrial" systems, the use of natural mating is generally predominant.

There is some variation in the main sources of the semen used in different production systems and species. In the case of cattle, imported exotic semen has the highest average score in most production systems. In contrast, in the case of small ruminants, imported exotic semen generally scores less than semen from locally adapted breeds and locally produced semen from exotic breeds. However, scores for AI with all types of semen are low in these species. In the case of pigs, the highest-scoring category in industrial systems, which are the main users of AI, is locally produced semen from exotic breeds.

Countries had the option of providing information on the use of biotechnologies in species other than the "big five". While the data may not be complete, they suggest that the use of biotechnologies in these species is not widespread (Table 3D4). Horses are to some extent an exception (particularly in Europe and the Caucasus and South America). Of the 62 countries that reported the presence of

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horses, 63 percent indicated that AI is used in this species. In the case of embryo transfer, 34 percent of these countries reported that the technology is used; in horses; 21 percent indicated the use of MOET. The use of molecular or genomic information in horses was reported by 29 percent of countries that report the presence of the species. The use of AI in buffaloes is also quite widely reported: of the 31 countries reporting the presence of the species, 58 percent indicated that AI is used. The use of other biotechnologies in "minor" species is apparently limited – in no cases reported in more than 25 percent of the countries reporting the presence of the species – and largely limited to the experimental level. In the case of some species with limited geographical distributions, the use of molecular and reproductive technologies for research purposes is reported by some countries where the respective species are economically important. For example, research on AI in South American camelids is reported in the country reports from the Plurinational State of Boliva and Peru. India and the Islamic Republic of Iran report research on AI, embryo transfer, MOET and *in vitro* fertilization in camels. The latter country also reports limited use of AI, embryo transfer and MOET for production purposes in Bactrian camels.

3. Stakeholders involved in services and research on reproductive and molecular biotechnologies

The country-report questionnaire requested countries to indicate which stakeholders (from a list of options[3]) are involved in providing artificial insemination and embryo transfer services to livestock keepers. The responses are summarized in Table 3D6. Globally, the public sector, breeders' associations or cooperatives and national commercial companies are the main players in the delivery of these services. However, there are major differences between regions. The public sector has no involvement in North America (represented only by the United States of America) and also in many countries in Europe and the Caucasus and the Southwest Pacific, but is widely involved in service delivery in other regions. Breeders' associations frequently have a role in Europe and the Caucasus, Asia and Latin America and the Caribbean, are less frequently involved in Africa and the Southwest Pacific and have no role in other regions. National commercial companies are widely involved in developed regions, somewhat less so in Latin America and the Caribbean and Asia, and quite rarely in other regions. In most regions, services are more frequently provided by national commercial companies (i.e. those based within the respective country) than by external companies. The involvement of NGOs is quite widespread in Asia, Africa and the Southwest Pacific, but less so elsewhere. Donors and development agencies have some involvement in the provision of services in all developing regions.

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[3] Public sector, breeders' associations or cooperatives, national non-governmental organizations, donors and development agencies, national commercial companies, external commercial companies.

Table 3D6. Stakeholder involvement in the provision of artificial insemination and embryo transfer services – regional breakdown

Regions and subregions	Technology	Number of countries	Breeders' associations or cooperatives	Donors and development agencies	External commercial companies	National commercial companies	National non-governmental organizations	Public sector
			%					
Africa	**AI**	**33**	**58**	**27**	**15**	**36**	**52**	**91**
	ET	**12**	**8**	**8**	**0**	**17**	**17**	**58**
East Africa	AI	7	57	43	14	43	71	100
	ET	5	0	20	0	0	20	60
North & West Africa	AI	14	57	36	29	50	50	86
	ET	3	33	0	0	33	33	67
Southern Africa	AI	12	58	8	0	17	42	92
	ET	4	0	0	0	25	0	50
Asia	**AI**	**16**	**75**	**50**	**38**	**69**	**56**	**100**
	ET	**15**	**40**	**20**	**27**	**33**	**27**	**67**
Central Asia	AI	3	100	33	67	67	33	100
	ET	3	67	33	67	67	33	100
East Asia	AI	3	67	100	67	100	67	100
	ET	3	67	67	67	100	67	100
South Asia	AI	5	60	40	0	60	60	100
	ET	4	0	0	0	0	0	25
Southeast Asia	AI	5	80	40	40	60	60	100
	ET	5	40	0	0	0	20	60
Southwest Pacific	**AI**	**4**	**50**	**50**	**100**	**50**	**50**	**50**
	ET	**2**	**100**	**50**	**100**	**100**	**100**	**50**
Europe & the Caucasus	**AI**	**35**	**83**	**9**	**66**	**91**	**26**	**55**
	ET	**29**	**66**	**7**	**50**	**73**	**20**	**39**
Latin America & the Caribbean	**AI**	**17**	**76**	**18**	**59**	**82**	**19**	**94**
	ET	**14**	**57**	**7**	**64**	**86**	**7**	**64**
Caribbean	AI	5	20	20	20	40	0	100
	ET	2	0	0	50	50	0	50
Central America	AI	4	100	25	50	100	33	100
	ET	4	50	0	75	75	0	75
South America	AI	8	100	13	88	100	25	88
	ET	8	75	13	63	100	13	63
North America	**AI**	**1**	**0**	**0**	**100**	**100**	**0**	**0**
	ET	**1**	**0**	**0**	**100**	**100**	**0**	**0**
Near & Middle East	**AI**	**6**	**0**	**17**	**17**	**33**	**0**	**100**
	ET	**2**	**0**	**0**	**0**	**0**	**0**	**50**
World	**AI**	**112**	**67**	**23**	**45**	**66**	**36**	**80**
	ET	**75**	**48**	**11**	**41**	**58**	**20**	**53**

Notes: AI = artificial insemination; ET = embryo transfer. "Number of countries" = the number of countries that report the availability of the respective technology at least at a low level for at least one species.

Countries were also asked to provide information on whether they are undertaking research on the biotechnologies discussed in this section. The responses are summarized in Tables 3D7 and 3D8. Where reproductive biotechnologies are concerned, research is most frequently reported in the more widely used technologies, AI followed by embryo transfer. Research on semen sexing and in vitro fertilization is somewhat less common and research on cloning and genetic modification even less so. The most common use of molecular genetic or genomic information in research is in the study of genetic diversity. Research on the use of molecular genetic or genomic information of prediction of breeding values and on adaptedness traits is also reported quite frequently. There are major differences between the regions. Research in all the fields of biotechnology under consideration is being conducted in North America. In most cases, research is also reported from a large proportion of countries in Europe and the Caucasus, East Asia and South America. Research activities are discussed in more detail in the regional overviews below.

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Table 3D7. Percentage of countries reporting research on reproductive biotechnologies – regional breakdown

Regions and subregions	Number of countries	Artificial insemination		Embryo transfer or MOET		Semen sexing		In vitro fertilization		Cloning	
		National	International	National	International	National	International	National	International	National	International
		%									
Africa	**40**	43	30	30	23	8	0	8	3	3	0
East Africa	8	50	25	63	50	13	0	13	13	0	0
North & West Africa	20	50	35	20	15	5	0	5	0	0	0
Southern Africa	12	25	25	25	17	8	0	8	0	8	0
Asia	**20**	80	35	75	45	45	20	55	25	35	25
Central Asia	4	75	25	75	25	50	25	50	0	25	0
East Asia	4	100	50	100	75	75	25	75	50	75	50
South Asia	6	83	17	67	33	17	0	33	17	17	0
Southeast Asia	6	67	50	67	50	50	33	67	33	33	50
Southwest Pacific	**7**	29	14	29	14	14	14	14	14	14	14
Europe & the Caucasus	**35**	83	49	57	40	43	37	57	37	26	20
Latin America & the Caribbean	**18**	61	28	67	22	33	6	56	28	22	11
Caribbean	5	40	20	20	0	0	0	0	0	0	0
Central America	5	60	0	80	0	60	0	60	20	0	0
South America	8	75	50	88	50	38	13	88	50	50	25
North America	**1**	100	0	100	0	100	0	100	0	100	0
Near & Middle East	**7**	86	43	14	14	14	0	14	14	0	0
World	**128**	64	35	49	30	28	15	37	20	18	12

Note: "National" refers to public or private research at national level and "international" refers to research undertaken as part of international collaboration.

Table 3D8. Percentage of countries reporting research on molecular biotechnologies – regional breakdown

Regions and subregions	Number of countries	Genetic modification		Use of molecular genetic or genomic information					
				for estimation of genetic diversity		for prediction of breeding values		for research on adaptedness	
		National	International	National	International	National	International	National	International
		%							
Africa	**40**	0	0	33	25	15	18	18	18
East Africa	8	0	0	50	38	13	13	25	25
North & West Africa	20	0	0	35	30	20	15	20	15
Southern Africa	12	0	0	17	8	8	25	8	17
Asia	**20**	30	15	60	40	50	30	45	20
Central Asia	4	25	0	50	25	50	50	25	0
East Asia	4	75	50	75	50	75	50	100	50
South Asia	6	17	0	67	33	17	0	17	0
Southeast Asia	6	17	17	50	50	67	33	50	33
Southwest Pacific	**7**	14	14	14	14	14	14	14	14
Europe & the Caucasus	**35**	29	23	89	80	74	71	63	51
Latin America & the Caribbean	**18**	22	11	50	39	39	33	28	22
Caribbean	5	0	0	0	0	0	0	0	0
Central America	5	20	0	40	20	20	20	0	0
South America	8	38	25	88	75	75	63	63	50
North America	**1**	100	0	100	100	100	100	100	100
Near & Middle East	**7**	0	14	57	57	14	0	29	14
World	**128**	17	12	55	46	41	36	37	28

Note: "National" refers to public or private research at national level; "international" refers to research undertaken as part of international collaboration.

4. Regional summaries

AI is the main, and in most cases the only, reproductive or molecular technology used in livestock production in African countries (Tables 3D1 and 3D2). AI use is reported by all the countries of East and Southern Africa, and by 74 percent of the countries of North and West Africa. However, the level of availability of AI is very variable across subregions, species and production systems. Only four of

the region's countries (Cameroon, Mauritius, South Africa and Rwanda) report that AI is widely available to livestock keepers (and these responses refer only to its use in cattle). Many countries report that a lack of infrastructure and logistical and human capacity means that they are only in the early stages of establishing AI services. For example, the country report from Benin notes that AI services were interrupted in 2010 because of a lack of liquid nitrogen. South Africa reports a relatively well-developed infrastructure for the provision of AI services (Box 3D3).

Box 3D3. The use of reproductive technologies in South Africa

South Africa currently has 32 registered reproduction centres that provide semen and embryo collection services, artificial insemination (AI) and embryo transfer in cattle, sheep, goats and horses. There are over 300 registered trained inseminators in the country (procedures for registration are regulated under the country's Animal Improvement Act of 1998). Some provide AI services to the smallholder sector, but most are either owners of commercial dairy farms or employed on such farms.
More extensive use of AI is restricted by the fact that most commercial beef and small-stock production takes place in extensive ranching systems. The commercial dairy sector is the largest user of reproductive biotechnologies (largely AI). Imported semen (mostly Holstein-Friesian), which is cheaper than nationally produced semen, is heavily used. Genetic evaluations are conducted by breed societies to ensure high standards are maintained. Over the past ten years, the pig industry has moved continuously towards the use of hybrid genetics and AI, which is provided by two companies. Imported embryos have been used to increase the numbers of Boran and Senepol cattle in the country, with varying degrees of success. Limited semen sexing and *in vitro* fertilization is done by a few registered service operators. Cloning (somatic cell nuclear transfer) has been limited to research, with one clone of a dairy cow having been successfully produced.

Source: Adapted from the country report of South Africa.

The availability of AI is much higher in industrial and small-scale peri-urban and urban systems than in other systems. Many countries, including Benin, the Gambia and South Africa, mention the preponderance of grassland systems as a constraint to the more widespread use of reproductive biotechnologies.

AI services in Africa are provided mainly by the public sector (Tables 3D6). The semen used may be imported or locally produced. In many countries, public institutions also provide AI technology and training to veterinarians and field technicians who then deliver services. Governmental AI services are frequently provided in collaboration with livestock keepers' associations and NGOs. The provision of AI services to livestock keepers is usually subsidized. For example the country reports from Botswana (Box 3D4), Ethiopia and Lesotho mention that semen doses are provided to livestock keepers at subsidized prices.

Box 3D4. The use reproductive technologies in Botswana

The animal breeding section of the Department of Animal Production (DAP) coordinates and oversees artificial insemination (AI) in Botswana. The DAP has a network of 14 AI camps, to which livestock keepers can bring their cattle for insemination. DAP also offers courses at which participants learn how to perform AI, so that they can use this technology on their own farms. Most of the people who attend the courses are owners or managers of dairy and beef cattle herds. The use of embryo transfer has also been explored. This technology has been applied experimentally on some farms, with very limited results.

Source: Adapted from the country report of Botswana.

The provision of AI services by private companies is much less widespread in Africa than provision by the public sector, in terms of the number of countries where the respective sectors are involved. The role of external commercial companies is particularly limited (Table 3D6). However, in the East

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and North and West Africa subregions, national commercial companies provide AI services in a substantial percentage of countries. For example, AI services in Kenya are provided mainly by private providers (including cooperatives), the public sector providing services only where there are no private-sector providers (country report Kenya). The country report from Senegal mentions that the government provides AI material to private veterinarians who act as service providers, often grouped into associations or consortia so as to be more competitive and to better organize the zoning of the programme. These organizations are also reported to work with foreign companies to obtain inputs. In other countries the government is in the process of trying to involve private companies in the provision of AI services (noted for example in the country report from Mauritania).

Other biotechnologies, such as embryo transfer and MOET, are reported to be used in some countries, but this is usually only for experimental purposes (Tables 3D7, 3D8, A3D1 and A3D2). The country report from Rwanda, for example, mentions that research on embryo transfer is being implemented by the Rwanda Agriculture Board in collaboration with Japanese researchers. Another example is provided in the report from the United Republic of Tanzania, which mentions that research on embryo transfer is being undertaken at the Agriculture University and that preparations are under way to construct a MOET laboratory at the Mpwapwa Livestock Research Institute. A few countries in the region report the use of embryo transfer at farm or livestock-keeper level, but only on a very limited scale.

Research in the field of biotechnology in Africa focuses mainly on improving AI techniques and extending it to other species than cattle, embryo transfer techniques and the estimation of genetic diversity in various livestock populations (Table 3D7 and 3D8). International collaboration in research in the field of biotechnology is widely reported, including both collaboration between African countries and those from outside the region (European and Asian countries) and collaboration between African countries. Examples include collaboration in research on embryo transfer involving Rwanda and Japan and Mozambique and South Africa (mentioned in the country reports from Rwanda and Mozambique).

AI is the most widely used reproductive biotechnology in livestock production in Asia. Every country report from the region states that this technology is used (Table 3D1). Embryo transfer and MOET technologies are also used in a very large percentage of the Asian countries. However, in most cases they are reported to be used only at research level. Japan and the Republic of Korea are exceptions in this respect and report that embryo transfer in commonly used in livestock production. The use of molecular genetic or genomic information is also widespread in the region, with the exception of Central Asia. According to the country reports, molecular information is used mainly in research projects on genetic characterization and diversity and to a limited extent to detect regions in the genome involved in the regulation of animal performance. India reports extensive research on growth traits in native and broiler chickens and trait-based gene profiles for egg quality traits (country report India). A few countries report explicitly that they have molecular and genomic breeding programmes in place. The country report from Japan, for example, mentions the use of genomic information in cattle breeding programmes. The report from Indonesia mentions the use of marked assisted selection in dairy and beef cattle and the report from Malaysia mentions its use in goats and cattle. The use of cloning technology for research purposes is mentioned in the country reports from India, Japan, the Republic of Korea and Thailand. The report from India notes that research institutions have successfully cloned buffaloes and sheep. The report from the Republic of Korea mentions that cloning has been used to restore native AnGR threatened with extinction.

In every reporting country in Asia, government and public institutions are very involved in the provision of reproductive biotechnology services directly to livestock keepers or to breeders' associations or private veterinarians that then provide the service to livestock keepers (Table 3D6). International donors, development agencies and NGOs also provide biotechnology services, mainly related to AI. They also have a role in supporting research and in technical education, particularly in the less-developed countries of the region. For example, the country report from Bangladesh notes that NGOs play a key role in expanding the use of AI. The country report from the Philippines mentions that Japan helped in the development of AI in the country and that the Republic of Korea provided support for the development of the cryopreservation facility of the Philippine Carabao Center. Private

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national and international companies have also a role in the provision of biotechnology services in some countries in the region, mainly in the dairy, pig and poultry sectors.

Country reports from East and Southeast Asia indicate research into almost all types of reproductive and molecular technology (Table 3D7 and 3D8). In Central and South Asia, research is reported to be less wide ranging, but a majority of countries report research on AI, embryo transfer and MOET and on the estimation of genetic diversity. Many research projects in the region involve international collaboration, usually involving, on the one hand, Asian countries with relatively well-developed research programmes and, on the other, those where research capacity is more limited. Some collaboration with countries outside the region is also reported. Mongolia is collaborating with the Chinese Academy of Science in a research project on the improvement of embryo transfer and MOET in cattle, sheep and goats, and with the Russian Academy of Agriculture Science and the Chinese Academy of Science in a molecular study of the genetic diversity of Mongolian cattle and yaks (country report Mongolia).

The countries of the Southwest Pacific region, fall into two distinct categories with respect to the level of use of reproductive and molecular technologies and the amount of research conducted in these fields: New Zealand and Australia[4] on the one hand and the small Pacific island countries on the other.

The country report from New Zealand indicates that for most livestock species, molecular and reproductive technologies are widely available for use in production. It gives a score of 3 (approximately >67 percent of matings), for the level of availability of AI, embryo transfer, MOET and molecular genetic or genomic information for use in the dairy and beef cattle and sheep and goat sectors. The same high level of availability is reported for the use of AI and molecular genetic or genomic information in the pig sector. National and international companies, as well as breeders' associations, are heavily involved in providing AI and embryo transfer services to livestock keepers (Table 3D6). The country also has a well-developed agricultural research sector, with extensive international links, that undertakes research into many of the technologies discussed in this section.

Half the country reports from the region's small island countries indicate that AI is used. This is mainly in the beef and, to a lesser extent, dairy sectors (see Annex). The report from the Cook Islands notes that AI is not being used because it is cheaper to import live animals than semen. In the countries where they are available, AI services are provided by external commercial companies or international donor and development agencies, with governments playing a facilitating role. Some countries report the need to further foster the use of AI. For example, the country report from Samoa notes that the government is interested in increasing the use of AI and embryo transfer technologies in breeding programmes. However, it also notes that there is a great need to increase capacity and raise awareness in this field. No other molecular or reproductive technologies are reported to be used in the small island countries of the region and no research on such technologies is reported.

In Europe and the Caucasus, national commercial companies, breeders' associations are the major actors in the provision of AI and embryo transfer services (Tables 3D6). The role of the public sector varies across the regions. Most often it is involved in research and in regulation (e.g. evaluating the semen quality and licensing companies for semen importation), in some cases it operates AI centres and services. The country report from France, states that the public sector was the main actor in the provision of reproductive technology services until 2010, after which the activity has been progressively taken over by veterinarians and the cooperative sector. External commercial companies are also significant service providers.

Most of the countries of the region report the widespread use of reproductive and molecular technologies (Tables 3D1 and 3D2). Research in the fields of genomics and general reproductive biotechnology is widespread. Research on cloning and genetic modification is less common (Tables 3D7 and 3D8). Research activities often involve international collaboration.

AI, embryo transfer, MOET, semen sexing, *in vitro* fertilization and molecular genetic and genomic information are reported to be used in a majority of countries in South and Central America (Tables

[4] Australia did not provide a country report as part of the second SoW-AnGR process, but it produced a country report in 2012 at its own initiative.

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3D1 and 3D2). Brazil (see Box 3D5) and Mexico are the leading countries in their respective subregions both in terms of the level of use of biotechnologies and in research. In Brazil, all the aforementioned technologies are used in cattle production. In the case of sheep, goats and pigs, AI, embryo transfer, molecular genetic and genomic information and MOET are used in production, but sexed semen and *in vitro* fertilization only in research. In most of the rest of the countries of South America, AI and embryo transfer, molecular genetic and genomic information and MOET are widely used in cattle and sheep production. In goats and pigs, AI is also widely used in production, but the use of embryo transfer, molecular genetic and genomic information and MOET is much less widespread (see Annex). Research on biotechnologies is also well developed in South America, mainly with regard to cattle and sheep; international collaboration in research is widespread (Table 3D7 and 3D8). The country reports from Peru and Bolivia mention research on optimizing the use of AI in llamas and alpacas. The reports from Argentina, Brazil and Uruguay mention research programmes on cloning and genetic modification.

Box 3D5. Use and research on biotechnologies for livestock production in Brazil

Artificial insemination: Although the use of artificial insemination (AI) is well established in Brazil, the growing use of fixed-time AI has given a new impulse to the use of this biotechnology. Currently, AI research focuses on the incorporation of fixed-time AI into different livestock-management systems.

Embryo transfer and MOET: The use of this technology in cattle production has gradually decreased, but research is still being undertaken with the aim of better selecting recipients and better maintaining pregnancies. There is ongoing research on the identification of molecular markers for use in selecting the best embryo donors. In other species, such sheep, research focuses on synchronization protocols and ovarian superstimulation.

Semen sexing: Sexed semen is routinely used in Brazil for *in vitro* fertilization. However, there are still problems with its use in AI and embryo transfer.

***In vitro* fertilization**: Brazil is the biggest producer of *in vitro* fertilized cattle embryos in the world. Research focuses oocyte donors, culture systems, oocyte quality, embryo quality and markers for embryo and oocyte selection. The cryopreservation of *in vitro* fertilized embryos and oocytes remains a major concern. Research is starting on *in vitro* fertilization protocols for sheep, goats, pigs and horses.

Cloning by nuclear transfer: Research in this area relates mainly to cell reprogramming (epigenetic studies) and transcriptome analysis of embryos, with the objective being to increase the efficiency of the technique.

Genetic modification: Most research on genetic modification is being done in cattle. Nuclear transfer using the transgenic cell is used to produce transgenic embryos. Due to the low efficiency of this technique, research is being done into the transfer of the new DNA into the embryo or zygote using lentiviral and retroviral vectors. Genetic modification studies in goats have resulted in the birth of the first transgenic animal in Brazil.

Source: Adapted from the country report of Brazil.

In Central America, AI, embryo transfer and MOET are used in livestock production, although to a lesser extent than in South America (see Annex). These technologies are used more widely in cattle (mainly in dairy cattle) than in other species. The country report from Mexico, for example, notes that these technologies are widely used in dairy cattle and that there is a federal government support programme that aims to spread the use of AI and embryo transfer in the livestock sector and to begin work on other technologies such as genomic selection. The country report from the Dominican Republic notes that the main providers of biotechnologies in the country are Brazilian and Mexican operators. Semen sexing and *in vitro* fertilization, and the use of molecular or genomic information in genetic evaluation, are reported to be undertaken for research purposes in dairy cattle in a few

countries (e.g. Mexico and Costa Rica). Outside the dairy sector, the country report from Mexico mentions that genetic association studies are being implemented in beef cattle and sheep.

In the Caribbean subregion, biotechnologies are reported to be much less available than in the rest of the region (Tables 3D1 and 3D2). AI is used to a limited extent in cattle and sheep. Research on embryo transfer and MOET is being undertaken in a few countries (Table 3D7). The country report from Jamaica mentions that research was done on the feasibility of artificially inseminating locally adapted goats using semen from Boer goats, but that a relatively low pregnancy rate was achieved.

The reported involvement of different stakeholders in the provision of biotechnology services is similar to that described above for Asia. Governmental institutions are relatively heavily involved in the provision of services in countries where livestock production is less well developed and for species kept mainly in less intensive systems. The reverse is true for commercial companies (Table 3D6). In Chile, for example, AI is widely practiced in cattle production. The use of this technology is fostered by the Institute of Livestock Development, but the main providers are commercial companies that import semen from exotic breeds (country report Chile). In Central and South America breeders' associations play an important role in the provision of AI and to a lesser extent embryo transfer.

In the United States of America, many biotechnologies are widely used in production (Box 3D6). Services are provided primarily by the private sector. Extensive research into the use of biotechnologies is also conducted (Table 3D7 and 3D8). Newly developed technologies are quickly transferred to the private sector, where they are used not only by large companies, but also by independent breeders. National and external commercial companies are the main providers of AI and embryo transfer services to livestock keepers (Table 3D6).

Box 3D6. Use of biotechnologies in livestock production in the United States of America

Dairy cattle: Sexed semen (female) is available from all large breeding companies and is widely used by dairy producers. Embryo transfer and *in vitro* fertilization are routinely used by breeders that provide bulls for artificial insemination. A genomic evaluation system has been developed, and nearly all bulls entering an artificial insemination programme have been subject to a genomic evaluation.

Beef cattle: Across the beef industry, the AI rate is low. Embryo transfer is used mainly by elite breeders to shorten generation intervals and increase the number of progeny from highly desirable bulls and cows.

Sheep: The sheep industry makes only limited use of artificial insemination, due to the limited success of transcervical AI using frozen semen. Embryo transfer is used mainly for importing new genetic resources. Marker assisted selection is undertaken, mostly related to selection for disease resistance.

Goats: Artificial insemination using frozen semen is widely used in the dairy goat industry, but less so in the meat and fibre industries. There is some embryo transfer, mostly associated with the propagation of imported genetics.

Pigs: AI utilizing chilled extended semen is highly integrated into pig production systems. The use of embryo transfer is very limited, because of the very low efficiency of embryo freezing in pigs. Marker assisted selection methodologies are starting to be used, and their use will expand as the accuracy of the marker panels is enhanced. Molecular modification methods are not currently utilized by the industry. Their development will depend on there being clear market signals that the use of genetic modified organisms is acceptable to consumers.

Chickens: Artificial insemination with fresh extended semen is used by chicken breeders. The advent of ovary transplantation represents a significant step in conserving poultry genetics. Marker assisted selection is implemented by large breeding companies.

Source: Adapted from the country report of the United States of America.

In the Near and Middle East, AI is the only reproductive biotechnology reported to be available to livestock keepers (Table 3D1). It is used mainly in the dairy cattle sector (Tables A3D1). AI is usually provided by public institutions, which distribute imported semen. However, a few countries report the involvement of private institutions. The country report from Egypt notes that private veterinarians

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provide AI services in cattle, buffalo and rabbits. The report from Sudan mentions that AI services were privatized in 2006 and that since then they have been provided by commercial companies.

Research in this field in the Near and Middle East is mainly related to AI and the estimation of genetic diversity, although the country report from Egypt also mentions that research on MOET, mainly for use in buffaloes, and on *in vitro* fertilization is being conducted by several institutions and universities. Some international collaboration in research is reported (Table 3D7 and 3D8). For example, the country report of Iraq mentions the involvement of the National Center for Genetic Resources Preservation of the United States of America in a study on the genetic diversity and structure of locally adapted breeds of cattle and sheep.

5. Changes since 2005

Table 3D9 presents a comparison of the level of use (presence or absence at country level) of AI and embryo transfer reported in the country reports prepared (between 2002 and 2005) for the first SoW-AnGR to the level reported in 2014. The figures refer to the countries that provided the relevant information in both reporting processes. Use of both AI and embryo transfer has become more widespread in terms of the number of countries where they are used. However, as discussed above, in many countries, their use is restricted to particularly production systems or locations. In the case of embryo transfer, availability for use in production is often very limited.

Table 3D9. Changes in the level of use of reproductive and molecular biotechnologies since 2005 – regional breakdown

Regions	Artificial insemination			Embryo transfer		
	n	2005	2014	n	2005	2014
		%			%	
Africa	34	82	88	20	25	20
Asia	12	100	100	8	63	100
Southwest Pacific	5	40	60	4	0	25
Europe & the Caucasus	31	100	100	17	82	88
Latin America & the Caribbean	15	93	100	9	100	100
North America	1	100	100	1	100	100
Near & Middle East	5	100	100	2	50	50
World	103	90	94	61	57	64

Note: The analysis is based on the 103 countries that provided the relevant information during both the first and the second SoW-AnGR processes.

The use of molecular genetic or genomic information in breeding programmes was indicated in very few of the country reports prepared for the first SoW-AnGR, It has become considerably more widespread in recent years, but in many cases remains at experimental level.

6. Conclusions and priorities

The information provided in the country reports indicates major gaps in the availability of reproductive and molecular biotechnologies for use in livestock sector. There has been some increase in their availability over recent years and the gap between developed and developing countries appears to have narrowed to some extent. Nonetheless, with the exception of AI, many countries report no use of any reproductive biotechnologies and the proportion of countries where their use extends beyond the experimental level is generally very low, particularly for species other than cattle. In some cases, the use of biotechnologies is restricted because technical issues related to the efficiency of their use in certain species, or generally, remain to be resolved. The use of some is restricted by social or ethical concerns. In other cases, however, the use of potentially beneficial technologies is restricted by a lack of funding, lack of infrastructure, lack of trained personnel or a lack of organizational capacity.

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A range of different stakeholders are involved in the provision of biotechnology services to livestock keeper. The private sector has at least some role in all regions, but public sector continues to play an important role in the delivery of services in developing regions, particularly in more marginal locations and production systems.

Reproductive and molecular biotechnologies are powerful tools for the management of AnGR, particularly for characterization, monitoring, breeding and conservation. Improvements to infrastructure can help to make these technologies more widely available to livestock keepers. However, if their use is to become more widespread, it is important that this takes place in the context of an in-depth understanding of AnGR management that considers the pros and cons of applying such powerful tools and the need both to increase livestock production and productivity and to maintain genetic diversity. As some of these technologies allow very rapid changes in the genetic make-up of livestock populations, it is important to carefully plan their use and adequately involve all relevant stakeholders.

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Annex. Use of reproductive and molecular technologies – species-level analysis

Table A3D1. Availability of AI, embryo transfer, molecular genetic or genomic information and MOET for use in dairy cattle – regional breakdown

Regions and subregions	Artificial insemination		Embryo transfer		Molecular genetic or genomic information		Multiple ovulation and embryo transfer	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**28**	**2.0**	**10**	**1.0**	**7**	**1.1**	**6**	**1.0**
East Africa	7	2.1	5	1.0	2	1.0	3	1.0
North & West Africa	9	1.8	2	1.0	3	1.0	1	1.0
Southern Africa	12	2.2	3	1.0	2	1.5	2	1.0
Asia	**15**	**2.6**	**14**	**1.2**	**9**	**1.4**	**12**	**1.2**
Central Asia	3	2.7	3	1.3	1	2.0	3	1.3
East Asia	3	2.7	3	1.7	2	2.0	2	1.5
South Asia	4	2.5	3	1.0	2	1.0	2	1.0
Southeast Asia	5	2.6	5	1.0	4	1.3	5	1.0
Southwest Pacific	**2**	**2.0**	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**
Europe & the Caucasus	**34**	**2.9**	**30**	**1.9**	**25**	**2.2**	**21**	**1.9**
Latin America & the Caribbean	**15**	**2.7**	**13**	**1.7**	**8**	**1.3**	**12**	**1.6**
Caribbean	4	2.5	2	1.0	0		1	1.0
Central America	4	2.5	4	1.3	3	1.0	4	1.3
South America	7	2.9	7	2.1	5	1.4	7	1.9
North America	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**
Near & Middle East	**3**	**2.3**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**
World	**98**	**2.5**	**70**	**1.6**	**52**	**1.8**	**54**	**1.6**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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Table A3D2. Availability of semen sexing, in vitro fertilization, cloning, genetic modification and transplantation of gonadal tissues for use in dairy cattle – regional breakdown

Regions and subregions	Semen sexing		*In vitro* fertilization		Cloning		Genetic modification		Transplantation of gonadal tissue	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**6**	**1.3**	**2**	**1.0**	**1**	**1.0**	**0**		**0**	
East Africa	4	1.3	1	1.0	0		0		0	
North & West Africa	1	1.0	1	1.0	0		0		0	
Southern Africa	1	2.0	0		1	1.0	0		0	
Asia	**10**	**1.5**	**8**	**1.3**	**4**	**1.0**	**4**	**1.0**	**2**	**1.0**
Central Asia	3	1.7	1	1.0	1	1.0	1	1.0	1	1.0
East Asia	2	2.0	2	2.0	2	1.0	2	1.0	1	1.0
South Asia	1	1.0	0		0		0		0	
Southeast Asia	4	1.3	5	1.0	1	1.0	1	1.0	0	
Southwest Pacific	**1**	**2.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**
Europe & the Caucasus	**21**	**2.0**	**16**	**1.3**	**5**	**1.0**	**2**	**1.0**	**2**	**1.0**
Latin America & the Caribbean	**7**	**1.7**	**10**	**1.2**	**2**	**3.0**	**2**	**1.5**	**1**	**1.0**
Caribbean	0		0		0		0		0	
Central America	4	1.0	4	1.0	0		0		0	
South America	3	2.7	6	1.3	2	3.0	2	1.5	1	1.0
North America	**1**	**3.0**	**1**	**3.0**	**1**	**2.0**	**1**	**1.0**	**0**	
Near & Middle East	**0**		**1**	**1.0**	**0**		**0**		**0**	
World	**46**	**1.8**	**39**	**1.3**	**14**	**1.4**	**10**	**1.1**	**6**	**1.0**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

Table A3D3. Availability of AI, embryo transfer, molecular genetic or genomic information and MOET for use in beef cattle – regional breakdown

Regions and subregions	Artificial insemination		Embryo transfer		Molecular genetic or genomic information		Multiple ovulation and embryo transfer	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**18**	**1.7**	**6**	**1.0**	**4**	**1.0**	**1**	**1.0**
East Africa	4	1.8	2	1.0	1	1.0	0	
North & West Africa	8	1.6	3	1.0	1	1.0	1	1.0
Southern Africa	6	1.7	1	1.0	2	1.0	0	
Asia	**9**	**2.3**	**5**	**1.2**	**5**	**1.2**	**2**	**1.5**
Central Asia	2	2.5	1	2.0	1	2.0	1	2.0
East Asia	1	2.0	1	1.0	0		0	
South Asia	4	2.5	2	1.0	2	1.0	0	
Southeast Asia	2	2.0	1	1.0	2	1.0	1	1.0
Southwest Pacific	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
Europe & the Caucasus	**24**	**2.7**	**17**	**1.9**	**18**	**1.9**	**11**	**1.8**
Latin America & the Caribbean	**9**	**2.1**	**8**	**1.5**	**5**	**1.0**	**7**	**1.3**
Caribbean	1	3.0	0		0		0	
Central America	3	1.7	3	1.0	2	1.0	3	1.0
South America	5	2.2	5	1.8	3	1.0	4	1.5
North America	**1**	**2.0**	**1**	**2.0**	**1**	**2.0**	**1**	**2.0**
Near & Middle East	**4**	**1.8**	**1**	**1.0**	**2**	**1.0**	**0**	
World	**65**	**2.2**	**38**	**1.6**	**35**	**1.5**	**22**	**1.6**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

Table A3D4. Availability of semen sexing, in vitro fertilization, cloning, genetic modification and transplantation of gonadal tissues for use in beef cattle – regional breakdown

Regions and subregions	Semen sexing		*In vitro* fertilization		Cloning		Genetic modification		Transplantation of gonadal tissue	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**2**	**1.5**	**1**	**1.0**	**0**		**0**		**0**	
East Africa	1	2.0	1	1.0	0		0		0	
North & West Africa	0		0		0		0		0	
Southern Africa	1	1.0	0		0		0		0	
Asia	**7**	**1.1**	**7**	**1.1**	**5**	**1.0**	**4**	**1.0**	**1**	**1.0**
Central Asia	2	1.5	1	1.0	1	1.0	1	1.0	0	
East Asia	2	1.0	2	1.5	2	1.0	2	1.0	1	1.0
South Asia	0		0		0		0		0	
Southeast Asia	3	1.0	4	1.0	2	1.0	1	1.0	0	
Southwest Pacific	**1**	**2.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**
Europe & the Caucasus	**14**	**1.9**	**13**	**1.2**	**3**	**1.0**	**2**	**1.0**	**2**	**1.0**
Latin America & the Caribbean	**4**	**2.3**	**8**	**1.4**	**2**	**3.0**	**2**	**1.5**	**1**	**1.0**
Caribbean	0		0		0		0		0	
Central America	1	1.0	2	1.0	0		0		0	
South America	3	2.7	6	1.5	2	3.0	2	1.5	1	1.0
North America	**1**	**2.0**	**1**	**3.0**	**1**	**2.0**	**1**	**1.0**	**0**	
Near & Middle East	**0**		**0**		**0**		**0**		**0**	
World	**29**	**1.8**	**31**	**1.3**	**12**	**1.4**	**10**	**1.1**	**5**	**1.0**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

Table A3D5. Availability of AI, embryo transfer, molecular genetic or genomic information and MOET for use in multipurpose cattle – regional breakdown

Regions and subregions	Artificial insemination		Embryo transfer		Molecular genetic or genomic information		Multiple ovulation and embryo transfer	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**4**	**1.3**	**1**	**1.0**	**2**	**1.0**	**1**	**1.0**
East Africa	0		0		0		0	
North & West Africa	2	1.0	0		1	1.0	0	
Southern Africa	2	1.5	1	1.0	1	1.0	1	1.0
Asia	**11**	**1.5**	**6**	**1.3**	**5**	**1.4**	**7**	**1.3**
Central Asia	3	2.0	1	3.0	1	2.0	2	2.0
East Asia	2	1.5	2	1.0	0		2	1.0
South Asia	2	1.5	1	1.0	2	1.0	1	1.0
Southeast Asia	4	1.0	2	1.0	2	1.5	2	1.0
Southwest Pacific	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**
Europe & the Caucasus	**23**	**1.7**	**13**	**1.3**	**18**	**1.6**	**11**	**1.1**
Latin America & the Caribbean	**13**	**1.8**	**10**	**1.5**	**6**	**1.7**	**8**	**1.5**
Caribbean	3	1.7	1	1.0	0		0	
Central America	3	1.0	3	1.0	1	1.0	3	1.0
South America	7	2.1	6	1.8	5	1.8	5	1.8
North America	**1**	**2.0**	**1**	**2.0**	**1**	**2.0**	**1**	**1.0**
Near & Middle East	**3**	**1.0**	**0**		**2**	**1.0**	**0**	
World	**56**	**1.6**	**32**	**1.4**	**35**	**1.6**	**29**	**1.3**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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Table A3D6. Availability of semen sexing, in vitro fertilization, cloning, genetic modification and transplantation of gonadal tissues for use in multipurpose cattle – regional breakdown

Regions and subregions	Semen sexing		*In vitro* fertilization		Cloning		Genetic modification		Transplantation of gonadal tissue	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**1**	**2.0**	**1**	**1.0**	**0**		**0**		**0**	
East Africa	1	2.0	1	1.0	0		0		0	
North & West Africa	0		0		0		0		0	
Southern Africa	0		0		0		0		0	
Asia	**2**	**1.5**	**2**	**1.0**	**1**	**1.0**	**2**	**1.0**	**0**	
Central Asia	1	2.0	1	1.0	0		1	1.0	0	
East Asia	0		0		0		0		0	
South Asia	0		0		0		0		0	
Southeast Asia	1	1.0	1	1.0	1	1.0	1	1.0	0	
Southwest Pacific	**0**		**0**		**0**		**0**		**0**	
Europe & the Caucasus	**13**	**1.9**	**9**	**1.3**	**4**	**1.0**	**2**	**1.0**	**2**	**1.0**
Latin America & the Caribbean	**3**	**1.3**	**5**	**1.2**	**1**	**1.0**	**0**		**0**	
Caribbean	0		0		0		0		0	
Central America	1	1.0	1	1.0	0		0		0	
South America	2	1.5	4	1.3	1	1.0	0		0	
North America	**1**	**1.0**	**0**		**0**		**0**		**0**	
Near & Middle East	**1**	**1.0**	**0**		**0**		**0**		**0**	
World	**21**	**1.7**	**17**	**1.2**	**6**	**1.0**	**4**	**1.0**	**2**	**1.0**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

Table A3D7. Availability of AI, embryo transfer, molecular genetic or genomic information and MOET for use in sheep – regional breakdown

Regions and subregions	Artificial insemination		Embryo transfer		Molecular genetic or genomic information		Multiple ovulation and embryo transfer	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**5**	**1.0**	**0**		**2**	**1.0**	**0**	
East Africa	1	1.0	0		1	1.0	0	
North & West Africa	1	1.0	0		0		0	
Southern Africa	3	1.0	0		1	1.0	0	
Asia	**13**	**1.2**	**7**	**1.0**	**8**	**1.3**	**9**	**1.0**
Central Asia	2	1.5	0		1	2.0	1	1.0
East Asia	2	1.5	2	1.0	0		2	1.0
South Asia	4	1.0	1	1.0	3	1.0	2	1.0
Southeast Asia	5	1.2	4	1.0	4	1.3	4	1.0
Southwest Pacific	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**
Europe & the Caucasus	**16**	**1.6**	**9**	**1.1**	**16**	**1.4**	**9**	**1.1**
Latin America & the Caribbean	**15**	**1.2**	**7**	**1.3**	**3**	**1.3**	**6**	**1.3**
Caribbean	5	1.4	0		0		0	
Central America	3	1.0	3	1.0	1	1.0	3	1.0
South America	7	1.1	4	1.5	2	1.5	3	1.7
North America	**1**	**3.0**	**1**	**2.0**	**1**	**2.0**	**1**	**1.0**
Near & Middle East	**3**	**1.0**	**0**		**2**	**1.0**	**0**	
World	**54**	**1.4**	**25**	**1.2**	**33**	**1.4**	**26**	**1.2**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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Table A3D8. Availability of semen sexing, in vitro fertilization, cloning, genetic modification and transplantation of gonadal tissues for use in sheep – regional breakdown

Regions and subregions	Semen sexing		*In vitro* fertilization		Cloning		Genetic modification		Transplantation of gonadal tissue	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**0**		**0**		**0**		**0**		**0**	
East Africa	0		0		0		0		0	
North & West Africa	0		0		0		0		0	
Southern Africa	0		0		0		0		0	
Asia	**3**	**1.7**	**5**	**1.0**	**4**	**1.0**	**2**	**1.0**	**0**	
Central Asia	1	3.0	1	1.0	1	1.0	1	1.0	0	
East Asia	1	1.0	2	1.0	1	1.0	1	1.0	0	
South Asia	0		1	1.0	1	1.0	0		0	
Southeast Asia	1	1.0	1	1.0	1	1.0	0		0	
Southwest Pacific	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**
Europe & the Caucasus	**1**	**1.0**	**6**	**1.0**	**3**	**1.0**	**1**	**1.0**	**2**	**1.0**
Latin America & the Caribbean	**2**	**1.0**	**4**	**1.3**	**3**	**1.0**	**1**	**1.0**	**1**	**1.0**
Caribbean	0		0		0		0		0	
Central America	1	1.0	1	1.0	0		0		0	
South America	1	1.0	3	1.3	3	1.0	1	1.0	1	1.0
North America	**0**		**0**		**0**		**0**		**0**	
Near & Middle East	**0**		**0**		**0**		**0**		**0**	
World	**7**	**1.3**	**16**	**1.1**	**11**	**1.0**	**5**	**1.0**	**4**	**1.0**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

Table A3D9. Availability of AI, embryo transfer, molecular genetic or genomic information and MOET for use in goats – regional breakdown

Regions and subregions	Artificial insemination		Embryo transfer		Molecular genetic or genomic information		Multiple ovulation and embryo transfer	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**5**	**1.0**	**0**		**2**	**1.0**	**0**	
East Africa	1	1.0	0		1	1.0	0	
North & West Africa	1	1.0	0		0		0	
Southern Africa	3	1.0	0		1	1.0	0	
Asia	**13**	**1.2**	**7**	**1.0**	**8**	**1.3**	**9**	**1.0**
Central Asia	2	1.5	0		1	2.0	1	1.0
East Asia	2	1.5	2	1.0	0		2	1.0
South Asia	4	1.0	1	1.0	3	1.0	2	1.0
Southeast Asia	5	1.2	4	1.0	4	1.3	4	1.0
Southwest Pacific	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**	**1**	**3.0**
Europe & the Caucasus	**16**	**1.6**	**9**	**1.1**	**16**	**1.4**	**9**	**1.1**
Latin America & the Caribbean	**15**	**1.2**	**7**	**1.3**	**3**	**1.3**	**6**	**1.3**
Caribbean	5	1.4	0		0		0	
Central America	3	1.0	3	1.0	1	1.0	3	1.0
South America	7	1.1	4	1.5	2	1.5	3	1.7
North America	**1**	**3.0**	**1**	**2.0**	**1**	**2.0**	**1**	**1.0**
Near & Middle East	**3**	**1.0**	**0**		**2**	**1.0**	**0**	
World	**54**	**1.4**	**25**	**1.2**	**33**	**1.4**	**26**	**1.2**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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Table A3D10. Availability of semen sexing, in vitro fertilization, cloning, genetic modification and transplantation of gonadal tissues for use in goats – regional breakdown

Regions and subregions	Semen sexing		*In vitro* fertilization		Cloning		Genetic modification		Transplantation of gonadal tissue	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**0**		**0**		**0**		**0**		**0**	
East Africa	0		0		0		0		0	
North & West Africa	0		0		0		0		0	
Southern Africa	0		0		0		0		0	
Asia	**2**	**1.0**	**5**	**1.0**	**4**	**1.0**	**3**	**1.0**	**0**	
Central Asia	0		1	1.0	1	1.0	1	1.0	0	
East Asia	1	1.0	1	1.0	1	1.0	1	1.0	0	
South Asia	0		1	1.0	1	1.0	1	1.0	0	
Southeast Asia	1	1.0	2	1.0	1	1.0	0		0	
Southwest Pacific	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**
Europe & the Caucasus	**1**	**1.0**	**7**	**1.0**	**3**	**1.0**	**2**	**1.0**	**1**	**1.0**
Latin America & the Caribbean	**2**	**1.0**	**2**	**1.5**	**2**	**1.0**	**2**	**1.5**	**1**	**1.0**
Caribbean	0		0		0		0		0	
Central America	1	1.0	1	1.0	0		0		0	
South America	1	1.0	1	2.0	2	1.0	2	1.5	1	1.0
North America	**0**		**0**		**0**		**0**		**0**	
Near & Middle East	**0**		**0**		**0**		**0**		**0**	
World	**6**	**1.0**	**15**	**1.1**	**10**	**1.0**	**8**	**1.1**	**3**	**1.0**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

Table A3D11. Availability of AI, embryo transfer, molecular genetic or genomic information and MOET for use in pigs – regional breakdown

Regions and subregions	Artificial insemination		Embryo transfer		Molecular genetic or genomic information		Multiple ovulation and embryo transfer	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**10**	**1.4**	**0**		**1**	**1.0**	**0**	
East Africa	2	1.0	0		0		0	
North & West Africa	3	1.0	0		0		0	
Southern Africa	5	1.8	0		1	1.0	0	
Asia	**9**	**1.7**	**4**	**1.3**	**5**	**1.4**	**4**	**1.5**
Central Asia	1	3.0	1	3.0	0		1	3.0
East Asia	2	2.5	2	1.0	2	1.5	2	1.0
South Asia	2	1.0	0		1	1.0	0	
Southeast Asia	4	1.3	1		2	1.5	1	1.0
Southwest Pacific	**3**	**2.3**	**1**	**1.0**	**2**	**2.0**	**1**	**1.0**
Europe & the Caucasus	**28**	**2.6**	**10**	**1.7**	**17**	**1.8**	**8**	**1.5**
Latin America & the Caribbean	**12**	**2.2**	**3**	**1.7**	**2**	**2.0**	**2**	**2.0**
Caribbean	5	2.2	0		0		0	
Central America	2	3.0	1	1.0	1	1.0	1	1.0
South America	5	1.8	2	2.0	1	3.0	1	3.0
North America	**1**	**3.0**	**1**	**1.0**	**1**	**3.0**	**1**	**1.0**
Near & Middle East	**0**		**0**		**0**		**0**	
World	**63**	**2.2**	**19**	**1.5**	**28**	**1.8**	**16**	

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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Table A3D12. Availability of semen sexing, in vitro fertilization, cloning, genetic modification and transplantation of gonadal tissues for use in pigs – regional breakdown

Regions and subregions	Semen sexing		*In vitro* fertilization		Cloning		Genetic modification		Transplantation of gonadal tissue	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**1**	**1.0**	**0**		**0**		**0**		**0**	
East Africa	0		0		0		0		0	
North & West Africa	0		0		0		0		0	
Southern Africa	1	1.0	0		0		0		0	
Asia	**5**	**1.4**	**3**	**1.0**	**3**	**1.0**	**2**	**1.0**	**1**	**1.0**
Central Asia	1	3.0	0		0		0		0	
East Asia	2	1.0	2	1.0	2	1.0	2	1.0	1	1.0
South Asia	0		0		0		0		0	
Southeast Asia	2	1.0	1	1.0	1	1.0	0		0	
Southwest Pacific	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**	**1**	**1.0**
Europe & the Caucasus	**3**	**1.0**	**7**	**1.0**	**3**	**1.0**	**3**	**1.0**	**1**	**1.0**
Latin America & the Caribbean	**1**	**1.0**	**0**		**0**		**1**	**1.0**	**1**	**1.0**
Caribbean	0		0		0		1	1.0	0	
Central America	0		0		0		0		0	
South America	1	1.0	0		0		0		1	1.0
North America	**0**		**0**		**0**		**1**	**1.0**	**0**	
Near & Middle East	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
World	**11**	**1.2**	**11**	**1.0**	**7**	**1.0**	**8**	**1.0**	**4**	**1.0**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

Table A3D13. Availability of AI, embryo transfer, molecular genetic or genomic information and MOET for use in chickens – regional breakdown

Regions and subregions	Artificial insemination		Embryo transfer		Molecular genetic or genomic information		Multiple ovulation and embryo transfer	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**3**	**1.0**	**0**		**2**	**1.0**	**0**	
East Africa	2	1.0	0		1	1.0	0	
North & West Africa	1	1.0	0		1	1.0	0	
Southern Africa	0		0		0		0	
Asia	**10**	**1.2**	**2**	**1.0**	**8**	**1.5**	**2**	**1.0**
Central Asia	2	1.0	0		1	2.0	0	
East Asia	2	1.5	1	1.0	2	2.0	1	1.0
South Asia	3	1.3	0		3	1.0	0	
Southeast Asia	3	1.0	1	1.0	2	1.5	1	1.0
Southwest Pacific	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
Europe & the Caucasus	**18**	**1.5**	**1**	**1.0**	**12**	**1.6**	**1**	**1.0**
Latin America & the Caribbean	**1**	**1.0**	**0**		**1**	**1.0**	**0**	
Caribbean	0		0		0		0	
Central America	1	1.0	0		0		0	
South America	0		0		1	1.0	0	
North America	**1**	**3.0**	**0**		**1**	**3.0**	**0**	
Near & Middle East	**0**		**0**		**1**	**1.0**	**0**	
World	**33**	**1.4**	**3**	**1.0**	**25**	**1.5**	**3**	**1.0**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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Table A3D14. Availability of semen sexing, in vitro fertilization, cloning, genetic modification and transplantation of gonadal tissues for use in chickens – regional breakdown

Regions and subregions	Semen sexing		*In vitro* fertilization		Cloning		Genetic modification		Transplantation of gonadal tissue	
	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score	Number of countries	Average score
Africa	**0**		**0**		**0**		**0**		**0**	
East Africa	0		0		0		0		0	
North & West Africa	0		0		0		0		0	
Southern Africa	0		0		0		0		0	
Asia	**2**	**1.0**	**3**	**1.0**	**2**	**1.0**	**3**	**1.0**	**1**	**1.0**
Central Asia	0		1	1.0	0		1	1.0	0	
East Asia	1	1.0	1	1.0	1	1.0	2	1.0	1	1.0
South Asia	0		0		0		0		0	
Southeast Asia	1	1.0	1	1.0	1	1.0	0		0	
Southwest Pacific	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
Europe & the Caucasus	**3**	**1.0**	**2**	**1.0**	**2**	**1.0**	**2**	**1.0**	**4**	**1.0**
Latin America & the Caribbean	**0**		**1**	**1.0**	**0**		**0**		**0**	
Caribbean	0		0		0		0		0	
Central America	0		0		0		0		0	
South America	0		1	1.0	0		0		0	
North America	**0**		**0**		**0**		**1**	**1.0**	**1**	**2.0**
Near & Middle East	**0**		**0**		**0**		**0**		**0**	
World	**5**	**1.0**	**6**	**1.0**	**4**	**1.0**	**6**	**1.0**	**6**	**1.2**

Note: Availability was scored on the following scale: none (0), low – at experimental level only (1), medium – available to livestock keepers in some locations or production systems (2) or high –widely available to livestock keepers (3). The n (number of countries) refers to the countries where the technology is reported to be used (i.e. non-responding countries and those that answered "none" are not included in the calculations). The scores shown are averages for these countries.

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SECTION E: LEGAL AND POLICY FRAMEWORKS

This section is divided into three major subsections, respectively addressing international, regional and national level legal and policy frameworks. As in the first report on *The State of the World's Animal Genetic Resources for Food and Agriculture* (first SoW-AnGR) (FAO, 2007a) the first two subsections are based mainly on a review of relevant literature. The subsection on national frameworks is based on country reporting.

1. International frameworks

The first SoW-AnGR described a number of international legally binding and non-binding instruments relevant to the management of AnGR.[1]This subsection presents an overview of developments since the time this report was prepared.

1.1. Management of biodiversity

Developments related to the work of the Convention on Biological Diversity

The Convention on Biological Diversity (CBD)[2] remains the main legally binding international framework for the management of biodiversity. From the perspective of AnGR management, significant developments in recent years have included an in-depth review of the CBD's Progamme of Work on Agricultural Biodiversity, as a result of which, in 2008, the Conference of the Parties (COP) to the CBD invited "Parties, other Governments, relevant international and regional organizations, local and indigenous communities, farmers, pastoralists and plant and animal breeders to promote, support and remove constraints to on-farm and *in situ* conservation of agricultural biodiversity through participatory decision-making processes in order to enhance the conservation of plant and animal genetic resources, related components of biodiversity in agricultural ecosystems, and related ecosystem functions" (Decision IX/1). Under the same decision, the COP welcomed the launch of the first SoW-AnGR and the adoption of the Global Plan of Action for Animal Genetic Resources (FAO, 2007b; see below for more details). It invited stakeholders to ensure the effective implementation of the plan.

In 2010, the COP adopted the Strategic Plan for Biodiversity 2011–2010, along with the Aichi Biodiversity Targets (Decision X/2). Of particular significance to AnGR management is Target 13:

> *"By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity."*

The COP invited FAO and its Commission on Genetic Resources for Food and Agriculture "to contribute to the implementation of the Strategic Plan for Biodiversity 2011-2020 by refining targets for agricultural biodiversity, including at the ecosystem and genetic resources levels, and monitoring progress towards them using indicators" (Decision X/34). At the same meeting, in 2010, the COP adopted the Nagoya Protocol (see below for further discussion).

In 2011, the second phase of the Joint Work Plan of the Secretariats of the CBD, FAO and the CGRFA, covering the period 2011 to 2020, was agreed upon. The key areas of work under this plan are assessments of biodiversity of relevance to food and agriculture, targets and indicators, best

[1] Part 3 Section E1, pages 275−284.
[2] http://www.cbd.int

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practices in the management of biodiversity, micro-organisms and invertebrates, access and benefit-sharing, enhancing implementation of the Strategic Plan for Biodiversity at national level, and climate change and genetic resources for food and agriculture (FAO, 2011a).

Developments related to the work of the Commission on Genetic Resources for Food and Agriculture

The first Sow-AnGR provided a short introduction to the role of the CGRFA as the only permanent intergovernmental forum specifically addressing matters related to biodiversity for food and agriculture. As far as AnGR management is concerned, the most significant development within the framework of the CGRFA in recent years has been the adoption of the Global Plan of Action for Animal Genetic Resources. The process of preparing the first Sow-AnGR led to the development of draft strategic priorities for action for AnGR management (FAO, 2007c). This provided the basis for the negotiation of the Global Plan of Action by the CGRFA and its adoption by the International Technical Conference on Animal Genetic Resources for Food and Agriculture, held in Interlaken, Switzerland, in September 2007, along with the Interlaken Declaration on Animal Genetic Resources. Later in 2007, the Conference of FAO adopted a resolution endorsing the Global Plan of Action (FAO, 2007d).

The Global Plan of Action contains 23 strategic priorities for action, grouped into four strategic priority areas: 1. Characterization, Inventory and Monitoring of Trends and Associated Risks; 2. Sustainable Use and Development; 3. Conservation; and 4. Policies, Institutions and Capacity-building. The strategic priorities, along with their main levels of implementation (national, regional or international are shown in Table 3E1.

In 2009, the CGRFA agreed a timetable for monitoring the implementation of the Global Plan of Action based on the preparation of periodical country progress reports (FAO, 2009a). The first round of reporting took place in 2012 and FAO prepared a progress report on the state of implementation (FAO, 2012). A further round of reporting followed as part of the reporting process for the preparation of the present report. The outcomes are described in the various sections of Part 3. In 2013, the CGRFA agreed upon a set of targets and indicators to be used to monitor the implementation of the Global Plan of Action and another set to be used to monitor the status and trends of AnGR (FAO, 2013a,b). The former set of indicators are referred to as “process indicators” (see Part 3 Section [crossref] for further discussion) and the latter as “resource indicators” (see Part 1 Section [crossref] for further discussion). Also in 2013, the CGRFA welcomed the idea of establishing a ten-year cycle for the preparation of state of the world reports for the various subsectors of genetic resources for food and agriculture. Following this cycle would mean that the next (third) SoW-AnGR would be published in 2025.

The Funding Strategy for the Implementation of the Global Plan of Action for Animal Genetic Resources was adopted by the CGRFA in 2009 (FAO, 2009a,b). An FAO trust account was established for the receipt of voluntary contributions in support of the implementation of the Global Plan of Action. All trust account funds are dispersed to countries to support implementation activities at national or regional level. By 2011, US$1 million had been contributed to the trust account and the first call for proposals under the Funding Strategy was launched. In 2012, 13 projects, involving 30 countries, were chosen to receive funding.[3]

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[3] For further details, see the Funding Strategy web site (http://www.fao.org/ag/againfo/programmes/en/genetics/first_call.html).

Table 3E1. Priority levels of implementation of the strategic priorities of the Global Plan of Action for Animal Genetic Resources

GLOBAL PLAN OF ACTION FOR ANIMAL GENETIC RESOURCES	STRATEGIC PRIORITY AREA 1 CHARACTERIZATION, INVENTORY AND MONITORING OF TRENDS AND ASSOCIATED RISKS	STRATEGIC PRIORITY AREA 2 SUSTAINABLE USE AND DEVELOPMENT	STRATEGIC PRIORITY AREA 3 CONSERVATION	STRATEGIC PRIORITY AREA 4 POLICIES, INSTITUTIONS AND CAPACITY BUILDING
NATIONAL	**SP 1** Inventory and characterize AnGR, monitor trends and risks associated with them, and establish country-based early-warning and response systems	**SP 3** Establish and strengthen national sustainable use policies **SP 4** Establish national species and breed development strategies and programmes **SP 5** Promote agro-ecosystems approaches to the management of AnGR **SP 6** Support indigenous and local production systems and associated knowledge systems of importance to the maintenance and sustainable use of AnGR	**SP 7** Establish national conservation policies **SP 8** Establish or strengthen in situ conservation programmes **SP 9** Establish or strengthen ex situ conservation programmes	**SP 12** Establish or strengthen national institutions, including national focal points, for planning and implementing AnGR measures, for livestock sector development **SP 13** Establish or strengthen national educational and research facilities **SP 14** Strengthen national human capacity for characterization, inventory, and monitoring of trends and associated risks, for sustainable use and development, and for conservation **SP 18** Raise national awareness of the roles & values of AnGR **SP 20** Review and develop national policies and legal frameworks for AnGR
REGIONAL			**SP 10** Develop and implement regional and global long-term conservation strategies	**SP 17** Establish Regional Focal Points and strengthen international networks
INTERNATIONAL	**SP 2** Develop international technical standards and protocols for characterization, inventory, and monitoring of trends and associated risks		**SP 11** Develop approaches and technical standards for conservation	**SP 15** Establish or strengthen international information sharing, research and education **SP 16** Strengthen international cooperation to build capacities in developing countries and countries with economies in transition, **SP 19** Raise regional and international awareness of the roles and values of AnGR **SP 21** Review and develop international policies and regulatory frameworks relevant to AnGR **SP 22** Coordinate the Commission's efforts on AnGR policy with other international forums **SP 23** Strengthen efforts to mobilize resources, including financial resources, for the conservation, sustainable use and development of AnGR

In addition to developments directly related to the implementation of the Global Plan of Action, the CGRFA has addressed a number of topics that are of relevance to AnGR management. For example, in 2013, the CGRFA adopted its Programme of Work on Climate Change and Genetic Resources for Food and Agriculture (FAO, 2013a). Also in 2013, it requested FAO to prepare *The State of the World's Biodiversity for Food and Agriculture*, which it stressed should focus on interactions between the various sectors of genetic resources (animal, plant, forest, aquatic, micro-organisms and invertebrates) and on cross-sectoral matters (ibid.).

Milestones and outputs for the CGRFA's work across all sectors of genetic resources and in cross-sectoral matters (access and benefit-sharing, climate change, biotechnology, biodiversity and nutrition) are set out in its Multi-year Programme of Work, which was adopted in 2007 and has been periodically revised (FAO, 2013). In 2009, the CGRFA adopted a Strategic Plan in which it identified the processes and the partners that would be needed in order to achieve the milestones set out in the Multi-year Programme of Work. A revised Strategic Plan, covering the period 2014 to 2023, was adopted in 2013 (ibid.).

1.2. Access and benefit-sharing

With regard to the international instruments in place at the time in the field of access and benefit-sharing (ABS), the first SoW-AnGR presented a short description of the relevant provisions of the CBD, the International Treaty on Plant Genetic Resources for Food and Agriculture (International Treaty) (FAO, 2009c) and, among "soft laws", the Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising out of their Utilization (CBD, 2002). It noted that while AnGR fall within the scope of the CBD, the specific characteristics and requirements of the AnGR subsector had received little attention in the development of international instruments related to ABS. A degree of concern had already been expressed about the potential effects that ABS frameworks might, directly or indirectly, have on the use of AnGR and other genetic resources for food and agriculture. In 2004, the CGRFA had recommended "that FAO and the Commission contribute to further work on access and benefit-sharing, in order to ensure that it move in a direction supportive of the special needs of the agricultural sector, in regard to all components of biological diversity of interest to food and agriculture" (FAO, 2004).

The main development in the field of ABS since the time of the first SoW-AnGR has been the adoption of the Nagoya Protocol (see below). Following the entry into force of the Nagoya Protocol on 12 October 2014, access to AnGR and traditional knowledge associated with them and the sharing of benefits arising from their use may increasingly be subject to legislative, administrative or policy measures.

During the course of the negotiations on the Nagoya Protocol, the FAO Conference, at the recommendation of the CGRFA, invited the negotiators "to explore and assess options … that allow for adequate flexibility to acknowledge and accommodate existing and future agreements relating to access and benefit-sharing." (FAO, 2009d). In 2011, the Commission decided to establish the Ad Hoc Technical Working Group on Access and Benefit-sharing for Genetic Resources for Food and Agriculture and mandated it to "identify relevant distinctive features of the different sectors and sub-sectors of genetic resources for food and agriculture requiring distinctive solutions; taking into account the relevant distinctive features identified, develop options to guide and assist countries, upon their request, in developing legislative, administrative and policy measures that accommodate these features; and analyze, as appropriate, possible modalities for addressing access and benefit-sharing for genetic resources for food and agriculture, taking into account the full range of options, including those presented in the Nagoya Protocol." (FAO, 2011b). The Ad Hoc Working Group met in July 2012 in Longyearbyen (Svalbard), Norway (FAO, 2012).

Following the adoption of the Nagoya Protocol, the CGRFA launched a process aimed at the development of "Draft Elements to Facilitate Domestic Implementation of Access and Benefit-Sharing for Different Subsectors of Genetic Resources for Food and Agriculture", intended as a voluntary tool to assist national governments with their work in this field (FAO, 2013a).

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The Nagoya Protocol – scope and objectives

The Nagoya Protocol was adopted on 29 October 2010 by the Conference of the Parties (COP) to the CBD at its tenth meeting, held in Nagoya, Japan. The objective of the Nagoya Protocol is to further advance the third of the three objectives of the CBD: the fair and equitable sharing of benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources.

In general, the assumption when selling genetic material in the form of breeding animals, semen, embryos, etc., is that its value as a genetic resource is already reflected in its price, and that the buyer will be free to use it for further research and breeding (FAO, 2009d). However, with the adoption of the Nagoya Protocol, things could change. The point of departure of the Nagoya Protocol is the sovereign right of states over their natural resources, which implies that the authority to determine access to genetic resources rests with national governments and is subject to national legislation. The sovereign right of states to determine access to genetic resources should not be confused with other categories of entitlement, such as the private ownership of an animal or genetic material. ABS measures may require that, even though an animal may be the private property of a farmer or the common property of a community, certain conditions (e.g. related to the need for "prior informed consent") must be met before it can be provided to a third party for research and development. Alternatively, governments can defer to providers and users to work out arrangements for access and benefit-sharing of privately held genetic resources, and can choose not to require the prior informed consent.

The Nagoya Protocol, in its preamble, explicitly recognizes the importance of genetic resources to food security, the special nature of agricultural biodiversity, its distinctive features and problems needing distinctive solutions, as well as the interdependence of all countries with regard to genetic resources for food and agriculture and the special nature and importance of these resources for achieving food security worldwide and for sustainable development of agriculture in the context of poverty alleviation and climate change. In this regard, the Nagoya Protocol also acknowledges the fundamental role of the CGRFA and of the International Treaty.[4] In its operational provisions, the Nagoya Protocol requires its Parties to consider, in the development and implementation of their access and benefit-sharing legislation or regulatory requirements, the importance of genetic resources for food and agriculture and their special role for food security.[5] However, the Nagoya Protocol does not specify how, in practice, ABS measures might take these matters into account.

It is important to note that the Nagoya Protocol does not prevent its Parties from developing and implementing other relevant international agreements, including other specialized access and benefit-sharing agreements, provided that they are supportive of and do not run counter to the objectives of the CBD and the Nagoya Protocol.[6] The Nagoya Protocol does not apply in respect of genetic resources covered by and for the purpose of such specialized instruments.[7] The Nagoya Protocol does not require its Parties to restrict access to any, or all, of their genetic resources.

Main provisions of the Nagoya Protocol and their relevance to animal genetic resources management

The Nagoya Protocol covers genetic resources, including AnGR, that are provided by Parties that are the countries of origin of the respective resources or by Parties that have acquired the resources in accordance with the CBD. The Nagoya Protocol requires Parties requiring prior informed consent for access to their genetic resources for "utilization", to take the necessary legislative, administrative or policy measures, in line with the provisions of the Protocol. The Protocol also addresses: access to traditional knowledge associated with genetic resources; the sharing of benefits derived from the utilization of genetic resources and of traditional knowledge associated with genetic resources; and

[4] Protocol, Preamble.
[5] Protocol, Article 8(c).
[6] Protocol, Article 4.2.
[7] Protocol, Article 4.4.

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the compliance of utilization of genetic resources and traditional knowledge with applicable requirements to obtain prior informed consent, where applicable, and to establish mutually agreed terms.

The Nagoya Protocol does not define "access to genetic resources". Instead it relies on the CBD definition of "genetic resources"[8] and introduces the concept of "utilization" of genetic resources, which according to the Nagoya Protocol means "to conduct research and development on the genetic and/ or biochemical composition of genetic resources, including through the application of biotechnology ..."[9] Thus, access to material that is not a genetic resource, and access to a genetic resource for purposes other than research and development on its genetic and/ or biochemical composition (e.g. access to milk for human consumption), are clearly outside the scope of the Nagoya Protocol. It remains to be seen whether, and to what extent, this definition of utilization proves to be useful in the AnGR subsector. Where, as in the case of AnGR, "research and development" and agricultural production occur in tandem, it may be difficult in some situations to distinguish "utilization" from activities related to production.

According to the Nagoya Protocol access to a genetic resource for its utilization shall be subject to the prior informed consent of the Party that is the country of origin of the resource or has acquired the resource in accordance with the CBD, unless otherwise determined by that Party. Countries of origin of genetic resources, according to the CBD, are countries that possess them "in *in situ* conditions", which are defined as "conditions where genetic resources exist within ecosystems and natural habitats, and, in the case of domesticated or cultivated species, the surroundings where they have developed their distinctive properties".[10] The Nagoya Protocol further states that benefits arising from the utilization of genetic resources shall be shared with the providing Parties in a fair and equitable way on the basis of mutually agreed terms.[11] A potential problem in this regard is that for animal breeds that are the result of dispersed contributions and that owe their development to a range of actors and environments in several different countries, it will often be difficult to determine in which country they developed "their distinctive properties."

The Nagoya Protocol also requires its Parties to "take measures, as appropriate, with the aim of ensuring that traditional knowledge associated with genetic resources that is held by indigenous and local communities is accessed with prior and informed consent or approval and involvement of these indigenous and local communities, and that mutually agreed terms have been established."[12] Parties shall also take measures to ensure that "the benefits arising from the utilization of traditional knowledge associated with genetic resources are shared in a fair and equitable way with the communities holding such knowledge, upon mutually agreed terms."[13]

A key component of the Nagoya Protocol are the compliance measures: appropriate, effective and proportionate measures to provide that genetic resources utilized within a Party's jurisdiction are of good legal status, i.e. have been accessed with prior informed consent, and that mutually agreed terms have been established, as required by the relevant domestic ABS measures.[14] The rationale of these compliance measures is to discourage illegal access to, or acquisition of, genetic resources. The utilization of resources that are not of good legal status may become a major legal, economic and reputational risk if this becomes subject to sanctions in all countries that are Parties to the Nagoya Protocol. To support compliance, countries have to monitor and enhance transparency about the utilization of genetic resources and associated traditional knowledge, including designating one or

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[8] "Genetic resources" mean "genetic material of actual or potential value." "Genetic material" is defined as "any material of plant, animal, microbial or other origin containing functional units of heredity." Biotechnology means "any technological application that uses biological systems, living organisms, or derivatives therefore, to make or modify products or processes for specific use." See CBD, Article 2.
[9] Protocol, Article 2.
[10] CBD, Article 2.
[11] Protocol. Article 5.1.
[12] Protocol, Article 7.
[13] Protocol Article 5.5.
[14] Protocol, Article 15.1.

more so-called checkpoints.[15] While the Nagoya Protocol's "user-country" measures may well have a deterrent effect in countries that implement and effectively enforce them, they may pose substantial administrative and logistical challenges in many countries. Similarly, Parties will need to consider the potential costs (transaction costs, administrative costs and other costs) of measures they are considering introducing in order to implement the Nagoya Protocol with respect to AnGR. The Nagoya Protocol does not distinguish between user and provider countries. All Parties will have to adopt user-country compliance measures.

1.3. Intellectual property rights

As noted in the first SoW-AnGR, rapid developments in the field of biotechnology have focused attention on the issue of intellectual property rights in relation to AnGR. Since 2007, the debate on these matters has continued in various international fora. While these debates continue, the World Trade Organization's (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement remains the main international legal framework in this field. While the TRIPS Agreement, under its Article 27, states that patents shall be available for any invention, whether product or process, in all fields of technology, it allows for some exemptions to patentability. Of particular relevance in the context of AnGR management is the following wording from paragraph 3(b) of Article 27: "Members may also exclude from patentability … plants and animals other than microorganisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes." At the same time, the TRIPS Agreement does not prescribe a specific notion of invention and does not explicitly bind WTO Member States either to allow or to forbid the patentability of substances existing in nature. For further information on the question of the patentability of substances existing in nature see WIPO (2011).

Box 3E1. Findings of a patent landscape report on animal genetic resources

Patenting activity for animal genetic resources for food and agriculture (AnGR) has received little attention so far in policy discussions. A WIPO patent landscape report prepared in collaboration with FAO establishes that patenting activity involving livestock occurs in the fields of biotechnology, pharmaceuticals, immunology and gene therapy, stem cells and transgenic animals. The research reveals that animals are important experimental models, sources of material for medical products and bioreactors for recombinant proteins. The patent landscape report identified six broad categories of AnGR-related technology development: artificial insemination, sex selection and control of oestrus; marker assisted breeding; transgenic animals; animal cloning; xenotransplantation; and animal models. To assist in future policy deliberations on access to AnGR and benefit-sharing, a flexible and updateable indicator has been developed to monitor trends in patent activity in the AnGR field in future years.

Key reproductive technologies in animal breeding such as artificial insemination, embryo transfer, in vitro fertilization and superovulation have a long history. The creation of a transgenic mouse using DNA microinjection in 1980 (the "oncomouse", see US4736866A) marked the emergence of genetically engineered animals. This was followed by somatic cell nuclear transfer and animal cloning in the 1990s. Patenting activity in these areas focuses on methods rather than specific genetic sequences. In parallel with these developments, phenotypic selection for breeding using Best Linear Unbiased Prediction (BLUP) approaches was increasingly complemented and in some cases replaced by DNA marker assisted breeding and genomic selection indexes from the early 2000s onwards. The completion of genome mapping projects for pigs (2012), zebu cattle (2012) and water buffalo (2014) are likely to accelerate trends towards the use of genomic selection indexes.

Patenting activity involving AnGR increased markedly in the late 1990s, focusing on expressed sequence tags (ESTs) and single nucleotide polymorphisms (SNPs). SNPs are important in marker assisted breeding for the identification of traits such as meat or milk quality. At the same time,

[15] Protocol, Article 17.1.

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patenting activity involving transgenic livestock also increased. However, activity involving AnGR declined sharply from 2001, caused by a combination of factors including an increasingly restrictive approach to the patentability of DNA sequences by patent offices and a lack of markets for food products from transgenic animals.

The majority of activity focuses on mainstream breeds and there is no substantive evidence of activity that might be considered to involve misappropriation or biopiracy of genetic resources and associated traditional knowledge in the patent data. Nevertheless, patent claims involving livestock are commonly constructed to include large groupings of animals (e.g. bovine, porcine or ruminant). Where granted and in force, such patents could affect the ability of farmers to utilize AnGR or specific technologies in breeding. Furthermore, trends towards genetic selection on economic traits, such as milk or meat quality or disease resistance, reflected in patent documents could have negative implications for the conservation of the global livestock gene pool. Genome mapping projects and the rise of commercial genomic selection indexes suggest the convergence of genomic information with software and business methods that may be eligible for patent protection. Trends in activity arising from genome sequencing projects merit careful attention with regard to their positive or negative implications for AnGR management. Finally, research disclosed in patents on disease control and climate change technologies could have wider applicability to farmers in developing countries, something that merits further research.

Provided by Eirini Kitsara, WIPO.
For further information, see: WIPO. 2014 Patent landscape report on animal genetic resources, by P. Oldham, S. Hall & C. Barnes. Geneva, Switzerland, World Intellectual Property Organization (available at http://www.wipo.int/edocs/pubdocs/en/wipo_pub_947_3.pdf).

Article 27.3(b) states that a review of provisions on optional exceptions to patentability should take place four years after the entry into force of the WTO Agreement, i.e. in 1999. This review did not reach a definitive conclusion. After the Doha Declaration of 2001 (WTO, 2001), the discussion on the review of Article 27.3(b) was broadened to include the relationship between the TRIPS Agreement and the CBD, as well as the protection of traditional knowledge and folklore. Debate on this issue is still ongoing. In addition to these developments in WTO fora, discussions on this topic are also taking place elsewhere. As noted in the first SoW-AnGR, in 2000, members of the World Intellectual Property Organization (WIPO) established an Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore. In 2009, WIPO members agreed to develop an international legal instrument (or instruments) that would give genetic resources, traditional knowledge and traditional cultural expressions effective protection. This process is also ongoing. In particular, WIPO members are considering whether, and to what extent, the intellectual property system should be used to ensure and track compliance with access and benefit-sharing systems in national laws established pursuant to the CBD, its Nagoya Protocol and the International Treaty.

One of the options under discussion is to develop mandatory disclosure requirements that would require patent applicants to show the source or origin of genetic resources, and also possibly evidence of prior informed consent and a benefit-sharing agreement. Another key issue is that of the defensive protection of genetic resources, so as to prevent patents that do not fulfil the patentability requirements of novelty and inventiveness from being granted over genetic resources and associated traditional knowledge. Defensive protection measures could include, for example, the creation of databases on genetic resources and traditional knowledge to help patent examiners find relevant prior art and avoid the granting of erroneous patents. Over the years, WIPO has developed a number of tools in the area of intellectual property and genetic resources, including a database of Biodiversity-related Access and Benefit-sharing Agreements[16] and Intellectual Property Guidelines for Access to Genetic Resources and Equitable Sharing of the Benefits arising from their Utilization (WIPO, 2013).

Other developments have taken place in the forum organized by WIPO's Standing Committee on the Law of Patents (SCP), established in 1998. The work of the Standing Committee led, in 2000, to the

[16] http://www.wipo.int/tk/en/databases/contracts/

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adoption of the Patent Law Treaty, which aims to harmonize certain formal aspects of the patent grant procedure. The scope of the Patent Law Treaty, however, does not cover substantive aspects of patent law. In order to harmonize the latter, the Standing Committee began in 2001 to discuss a draft substantive patent law treaty. In 2006, the draft was put aside because no consensus had been reached on it. Although the draft treaty has been abandoned for the time being, the importance of conducting an international debate on substantive patent law has been recognized and the Standing Committee has been maintained. Currently, there are five topics concerning substantive patent law under debate within the Standing Committee, namely: exceptions and limitations to patent rights; technology transfer; quality of patents, including opposition systems; confidentiality of communications between patent advisors and their clients; and patents and health.

As noted in the first SoW-AnGR, the TRIPS Agreement also includes provisions related to geographical indications. Given that marketing speciality products is a potential means of keeping at-risk livestock breeds in use, these provisions have some significance for AnGR management (see Part 4 Section [crossref]). Article 22 defines geographical indications as "indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin." Member countries are obliged to provide legal means by which the "use of any means in the designation or presentation of a good that indicates or suggests that the good in question originates in a geographical area other than the true place of origin in a manner which misleads the public as to the geographical origin of the good" can be prevented. Article 23 provides additional protection for geographical indications for wines and spirits.

Articles 22 and 23 have been subject to negotiations under the Doha Round.[17] A special session of the Council for TRIPS[18] has been negotiating the establishment of a multilateral register for wines and spirits, which would register geographical indications for wines and spirits and provide notification of the registries for those Members using the system. Linked to the negotiations of the multilateral register, are discussions on the extension of the higher level of protection, as provided for in Article 23, beyond wines and spirits. Members remain deeply divided on this issue. Those in favour of expanding the register have argued that a higher level of protection for more goods is a better way to defend and market locally based products (e.g. WTO, 2005). Those in opposition have argued that the existing level of protection is adequate and that expanding protection would create unnecessary burdens that disrupt legitimate marketing practices (Taubman *et al*., 2012). As part of the ongoing review pursuant to Article 24.2 of the TRIPS Agreement, negotiations on other matters related to geographical indications continue under the auspices of the Council for TRIPS. These include a stock-taking exercise of national practices on the basis of a list of questions developed in 1998 (WTO, 1998) and of a reporting exercise on bilateral agreements related to geographical indications requested by the Council for TRIPS in 2010 (WTO, 2010).

The issue of patenting in the AnGR subsector has always been controversial. While some stakeholders argue that the possibility of obtaining a patent helps to stimulate innovation, others express a range of ethical and socio-economic concerns.[19] The trend towards greater use of the intellectual property rights system to incentivize and protect advances in breeding and associated technologies has been one of the factors motivating various civil society organizations to advocate the establishment of so-called "livestock keepers rights" (see Part 3 Section 1) and biocultural community protocols (see Part 4 Section [crossref]).

1.4. Regulation of international trade, including zoosanitary issues

The first SoW-AnGR noted that the main international legal framework regulating trade livestock and livestock products was provided by the WTO's Agreement on Agriculture (adopted in 1994) and

[17] The Doha Round is the round of trade negotiations that began in 2001.
[18] http://www.wto.org/english/tratop_e/trips_e/gi1_docs_e.htm
[19] See pages 285 to 290 of the first SoW-AnGR for a discussion of these issues.

DRAFT - NOT FOR CITATION

provided a short overview of the basic principles of the WTO's various trade agreements. It noted that the trade in animals and animal products is greatly affected by zoosanitary rules, i.e. many countries' ability to trade is limited by their having a poorer disease status than potential trading partners. This can have a knock-on effect on AnGR management. For example, access to breeding animals or genetic material may be restricted and restrictions on access to export markets may affect demand for livestock products and hence the profitability of using different types of AnGR. The WTO's Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) aims to ensure that trade restrictions are minimized by requiring that members ensure "that any sanitary or phytosanitary measure is applied only to the extent necessary to protect human, animal or plant life or health, is based on scientific principles and is not maintained without sufficient scientific evidence ..." (Article 2, paragraph 2). Measures that "conform to international standards, guidelines or recommendations" are "deemed to be necessary to protect human, animal or plant life or health, and presumed to be consistent with the relevant provisions [of the agreement]" (Article 3, paragraph 2). In the case of animals and animal products the relevant international standards are those of the World Organisation for Animal Health (OIE)[20] and the Codex Alimentarius Commission.[21] Countries can implement more restrictive standards if there is scientific justification or if determined to be appropriate based on the risk assessment procedures set out in the agreement (Article 3, paragraph 3).

The legal framework for trade and zoosanitary matters that was in place in 2005/2006 remains largely unchanged in 2014. One issue that has become increasingly prominent in recent years is the question of private-sector standards, such as those set by supermarket chains. Standards of this type have the potential to affect demand for animal products and hence the use and development of AnGR. In 2011, the WTO's Committee on Sanitary and Phytosanitary Measures agreed to take some actions aimed at reducing the potential negative effects of private-sector standards on countries' abilities to trade internationally (WTO, 2011). Discussions on this topic have continued, but at the time of writing remain unresolved.

1.5. Conclusions

As far as legally binding instruments relevant to the management of AnGR are concerned, the most significant development of recent years has been the adoption and, on 12 October, 2014, entry into force of the Nagoya Protocol. The implications for the AnGR subsector are not yet clear. Efforts to ensure that appropriate provisions for the various subsectors of food and agriculture are ongoing, inter alia under the auspices of the CGRFA. Negotiations on various international legal frameworks that may directly or indirectly affect the management of AnGR, most notably on issues related to international trade and intellectual property rights, are ongoing. The Global Plan of Action for Animal Genetic Resources notes the need to ensure that the various international instruments that affect countries' capacities to exchange, use and conserve AnGR, and to trade in animal products, are mutually supportive. It calls for a review of such frameworks "with a view to ensuring that [they] international policies and regulatory frameworks take into account the special importance of animal genetic resources for food and agriculture for food security, the distinctive features of these resources needing distinctive solutions, the importance of science and innovation, and the need to balance the goals and objectives of the various agreements, as well as the interests of regions, countries and stakeholders, including livestock keepers." Whether or not AnGR-related concerns are successfully mainstreamed into negotiations related to the ongoing development of international legal frameworks, these frameworks will continue to influence the development of the livestock sector internationally and hence to affect the use of AnGR, potentially creating both threats and opportunities. It is therefore important that stakeholders involved in AnGR management pay attention to developments in the international legal arena and have the capacity to follow them and interpret their implications for the subsector. There may be some need for capacity-development and awareness-raising in this field.

[20] http://www.oie.int/
[21] http://www.codexalimentarius.org/

DRAFT - NOT FOR CITATION

In terms of international policy, the major development since the preparation of the first SoW-AnGR was the adoption of the Global Plan of Action in 2007. The state of implementation of the Global Plan of Action is discussed elsewhere in this report. However, countries' ongoing commitment to the process has been demonstrated by developments at meetings of the Commission such as the adoption of the Funding Strategy for the Global Plan of Action and the establishment of a mechanism for monitoring implementation, as well as by the large number of countries that reported on their implementation activities in 2012 and 2014. The Global Plan of Action was envisaged as a rolling plan, with an initial time horizon of ten years. As part of the second SoW-AnGR reporting process, countries were given the opportunity to indicate any aspects of AnGR management not currently addressed in the Global Plan of Action that would be important to address in the future, again with a time horizon of approximately ten years. The responses to this question are discussed in Section [crossref].

The adoption of the CBD's Strategic Plan for Biodiversity and the Aichi Targets, including Target 13 on the maintenance of genetic diversity, was another significant development. Updated national biodiversity strategy and action plans, the main instruments for the implementation of the CBD at country level, are increasingly including references to AnGR and actions related to their management (see the subsection on national policy and legal frameworks, below, for further discussion).

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2. .Regional frameworks

This subsection discusses the effects of legal and policy frameworks at regional level (i.e. applying to a group of countries) on the management of AnGR, focusing particularly on developments since the first SoW-AnGR was drafted in 2005/2006. The equivalent subsection in the first SoW-AnGR

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focused largely on legal and policy framework in place in the European Union (EU),[22] because of its comprehensive nature and many AnGR-relevant provisions. EU frameworks are, similarly, the main focus of this updated analysis (particularly given that the frameworks in most of the fields discussed in the first AnGR have been updated during the intervening period). Regional-level policy frameworks, and in particular regional-level legally binding instruments, in fields relevant to AnGR management are rare in other regions. The discussion of instruments outside the EU is therefore inevitably relatively brief. Initiatives at regional level not specifically related to legal and policy frameworks, particularly the activities of regional focal points for the management of AnGR, are discussed in Part 3 Section 1.

2.1. The European Union

As described in the first SoW-AnGR, EU legislation relevant to AnGR management addresses a range of different topics, including conservation, zootechnics (animal breeding), animal health, trade in animals and animal products, organic agriculture, food and feed safety, the use of genetically modified organisms (GMOs) and access and benefit-sharing. The EU utilizes several different types of legal instrument, some of which are binding and some of which are not. Binding instruments fall into three categories: regulations, directives and decisions. A regulation is a legislative act that must be applied in its entirety across the whole EU. A directive sets out goals that member countries must achieve, but leaves it up to countries to decide how they wish to achieve the these goals. A decision is binding on those (e.g. an EU country or an individual company) to whom it is addressed and is directly applicable (EU, 2014a).

General frameworks addressing agriculture, rural development and biodiversity

The EU's Common Agricultural Policy (CAP) comprises a set of rules and mechanisms that regulate the production, trade and processing of agricultural products in the EU. It has a major influence on the agricultural sector in EU member countries and has major implications for the management of all resources used in agriculture, including AnGR. The first SoW-AnGR emphasized the significance for AnGR management of the reforms to the CAP that had occurred over the preceding decade and a half, particularly the introduction of agri-environmental schemes, first under Council Regulation (EEC) No. 2078/92 and then under Council Regulation (EC) No. 1257/99. At the time the ffirst SoW-AnGR was written, Council Regulation (EC) No. 1698/2005, a new act providing a framework for support for rural development, financed by the European Agricultural Fund for Rural Development, had recently been passed. The objective of the fund, whose first funding period ended in 2013, is to improve the competitiveness of agriculture and forestry, the state of the environment and the countryside, and the quality of life and economic activity in rural areas (EU, 2012). On the basis of strategic guidelines (Council Decision 2006/144/EC), EU member countries developed national rural development strategy plans (RDP) for the 2007 to 2013 period. These plans constituted the reference framework for rural development programmes featuring measures grouped around four "axes": 1. improving the competitiveness of the agricultural and forestry sector; 2. improving the environment and the countryside; 3. quality of life in rural areas and diversification of the rural economy; and 4. "LEADER" (related to local development strategies involving public–private partnerships). Council Regulation (EC) No. 1698/2005 states specifically (Article 39) that, under Axis 2, agri-environment payments can be provided for the conservation of genetic resources in agriculture. The actions under the other axes do not directly target AnGR. However, they potentially influence demand for different types of AnGR via demand for the various products and services that they provide. Measures that promote the diversification of the rural economy and the economic sustainability of rural livelihoods, particularly those of smaller-scale producers in harsh or remote production systems, have at least some potential to provide indirect support to the maintenance of diverse AnGR.

[22] Member states: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

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The background to these developments was the CAP reform of 2003, with the decoupling of farm support payments from production and the introduction of so-called single farm payments (Council Regulation (EC) No 1782/2003; Council Regulation (EC) No 73/2009). This, in theory, had the potential to reduce the profitability of keeping at-risk breeds and bring about a fall in their population sizes, unless alternative economic incentives emerged (Canali and the Econogene Consortium, 2006). Concerns were also expressed about an increase in the minimum area eligible for single farm payments, because of the significant role played in breed conservation by part-time farmers operating on small areas of land (RBST, 2009). Zjalic (2008) noted that the expected decline in the overall number of sheep and goats in the EU as a result of decoupling could prove to be a threat to some breeds, but also that agri-environmental schemes providing payments for raising at-risk breeds might become increasingly attractive as an alternative source of income. However, such reflections are inevitably rather speculative. A review undertaken in 2010, based on consultations with National Coordinators for the Management of Animal Genetic Resources from EU countries (Zjalic, 2010), however, suggested that the effects of the reforms on the status of at-risk breeds had generally not been large.

In 2010, the European Commission launched a public debate on the future of the CAP, which attracted 5700 submissions from stakeholders, think tanks and research organizations, and the general public. The report summarizing the outcome of the process concluded there was considerable consensus among EU citizens that the objectives of agriculture in the EU should be "provision of a safe, healthy choice of food, at transparent and affordable prices; ensuring sustainable use of the land; activities that sustain rural communities and the countryside; and security of food supply (European Commission, 2010). The specific "directions to be followed" identified via the consultation process included "protect[ing] the environment and biodiversity, conserve the countryside, sustain the rural economy and preserve/create rural jobs, mitigate climate change" (ibid.).

In 2011, the Commission presented a set of legal proposals for the future of the CAP (EU, 2014b) and an "impact assessment" of various policy options (European Commission, 2011). In June 2013, political agreement on CAP reform was reached. In December of the same year, four basic regulations were adopted – Regulation (EU) No 1305/2013 on rural development, Regulation (EU) No 1306/2013 on "horizontal" issues such as funding and controls, Regulation (EU) No 1307/2013 on direct payments to farmers and Regulation (EU) No 1308/2013 on market measures – along with transitional rules for the year 2014. Under the regulation on rural development, "agri-environment-climate" support payments can be made "for the conservation and for the sustainable use and development of genetic resources in agriculture." Under the same regulation, the European Commission is also empowered to adopt delegated acts[23] related to "the conditions applicable to commitments to rear local breeds that are in danger of being lost to farming or to preserve plant genetic resources that are under threat of genetic erosion." In this regard, Commission Delegated Regulation (EU) No 807/2014, adopted in March 2014, sets out rules for determining whether a breed is "in danger of being lost to farming." In contrast to previous arrangements, the new framework does not include a set of population thresholds. Member states are required to determine for themselves whether breeds fall into this category. The following conditions must be met: "(a) the number of breeding females at national level concerned is stated; (b) that number and the endangered status of the listed breeds is certified by a duly recognised relevant scientific body; (c) a duly recognised relevant technical body registers and keeps up-to-date the herd or flock book for the breed; (d) the bodies concerned possess the necessary skills and knowledge to identify animals of the breeds in danger."

The effects that the other aspects of the 2014 CAP reform will have on AnGR management are difficult to predict. Developments such as the provision of support for young people entering the agricultural sector and a range of measures to support the economic and social vitality of rural areas, along with the above-mentioned agri-environmental measures, are broadly compatible with efforts to support livestock-keeping livelihoods that involve the use of breeds that are at risk, or potentially at

[23] The European Commission may be delegated "power to adopt non-legislative acts of general application to supplement or amend certain non-essential elements of the legislative act" (Article 290 of the Treaty on the Functioning of the European Union – available at http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:C:2010:083:FULL&from=EN).

DRAFT - NOT FOR CITATION

risk, of extinction (SAVE Foundation, 2013). With regard to the abolition of milk quotas, the country report from Poland notes that this is likely to have a significant effect on the utilization of AnGR, although exact outcomes are difficult to predict. The report notes that Poland has a high potential to increase dairy production and that concentration of the sector might be very rapid and lead to substantial breed replacement.

In 2012, the European Commission launched the European Innovation Partnership "Agricultural Productivity and Sustainability" (EIP-AGRI) (European Commission, 2012a). European Innovation Partnerships are intended to "address weaknesses, bottlenecks and obstacles in the European research and innovation system that prevent or slow down good ideas being developed and brought to market" (European Commission, 2012b). The communication that launched EIP-AGRI heavily emphasizes the role of agricultural genetic resources, noting that "making use of European genetic diversity unlocks a vast potential for development." Roles are foreseen across most of the "areas of innovative actions" described in the document, which range from "increased agricultural productivity, output, and resource efficiency" to "biodiversity, ecosystem services, and soil functionality" and "innovative products and services for the integrated supply chain." A focus group on "genetic resources – cooperation models" has been established and held its first meeting in early 2014 (European Commission, 2014a).[24]

In the general field of biodiversity conservation and management, significant policy developments in recent years have included the adoption by the European Parliament (EU, 2007) of the 2006 Biodiversity Communication and Action Plan: "Halting the loss of biodiversity by 2010 – and beyond" (European Commission, 2006a, 2006b, 2006c). The plan included a set of objectives, targets and actions. Most relevant to AnGR were Objective 2: "To Conserve and Restore Biodiversity and Ecosystem Services in the Wider EU Countryside", which under the heading "Agricultural and rural development policy" included the target "Member States have optimised use of opportunities under agricultural, rural development and forest policy to benefit biodiversity 2007–2013" and the action "Strengthen measures to ensure conservation, and availability for use, of genetic diversity of crop varieties, livestock breeds and races, and of commercial tree species in the EU, and promote in particular their *in situ* conservation."

In 2011, the European Commission adopted the EU Biodiversity Strategy to 2020, which includes the headline target of "Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss" (EU, 2011). Genetic resources for food and agriculture are targeted under several actions, including via references to facilitating "collaboration among farmers and foresters to achieve continuity of landscape features, protection of genetic resources and other cooperation mechanisms to protect biodiversity" (Action 9), encouraging "the uptake of agri-environmental measures to support genetic diversity in agriculture and explore the scope for developing a strategy for the conservation of genetic diversity" (Action 10) and regulating "access to genetic resources and the fair and equitable sharing of benefits arising from their use" (Action 20). In 2012, the European Parliament adopted a resolution – P7_TA(2012)0146 – on the biodiversity strategy. Of particular relevance to AnGR management are paragraphs 71 and 72 of the resolution, which call for "appropriate legislation and incentives for the maintenance and further development of diversity in farm genetic resources, e.g. locally adapted breeds and varieties" and stress "the need for more effective cooperation at European level in the field of scientific and applied research regarding the diversity of animal and plant genetic resources in order to ensure their conservation, improve their ability to adapt to climate change, and promote their effective take-up in genetic improvement programmes."

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[24]Further information can be found on the European Commission website: http://ec.europa.eu/agriculture/eip/documents/eip-opportunities_en.htm#eip-origins-of-eip-agri (EIP-AGRI); http://ec.europa.eu/agriculture/eip/focus-groups/genetic-resources/index_en.htm (focus group on genetic resources).

Animal genetic resources management

This subsection discusses instruments that specifically target the management of AnGR. These instruments fall roughly into two categories: those targeting animal breeding or "zootechnics" and those targeting the broader sustainable management of AnGR, with particular emphasis on breeds that are at risk of extinction. As described above, Council Regulation (EC) No. 1698/2005 allowed for the provision of agri-environment payments for the conservation of genetic resources in agriculture and similar provisions are now in place under Regulation (EU) No 1305/2013. These payments are the mainstays of support for *in situ* conservation measures in the EU. However, support for a range of activities related to the conservation and sustainable use of AnGR is also addressed within the framework of Council Regulation (EC) No. 870/2004, which established a second Community Programme on the "conservation, characterization, collection and utilization of genetic resources in agriculture." Actions that can potentially receive support under the programme include those related to establishing inventories of conservation measures and the exchange of scientific and technical information, as well as those more directly related to conservation (*in situ* and *ex situ*), characterization, etc. Seventeen co-funded actions under the programme commenced in 2007, with a maximum duration of four years (European Commission, 2013a).[25] Five of these projects targeted AnGR: Towards Self-sustainable European Regional Cattle Breeds;[26] An Integrated Network of Decentralized Country Biodiversity and Genebank Databases;[27] Heritage Sheep;[28] European Livestock Breeds Ark and Rescue Net;[29] and A Global View of Livestock Biodiversity and Conservation.[30]

An independent expert evaluation of the Community Programme published in 2012 (European Commission, 2013b) noted a number of positive outcomes and recommended that the programme should be continued. It concluded that the programme had: "a. stimulated considerable interest among various groups of stakeholders within the European Union and beyond; b. promoted collaboration among diverse groups of stakeholders in different countries; c. led to the establishment of useful links and partnerships across Europe; d. advanced the understanding of some local practices and needs; e. led to useful results and guidelines for the conservation of valuable genetic resources; f. established well characterised and evaluated core collections and cryo-banks of various plant and animal species; and g. improved the scientific knowledge on the nature, management and potential of genetic resources of some species of farm animals, crops and forest trees in Europe." However, the assessment noted that the utilization component of the programme had not been addressed to the same extent as the other components. To address this gap, it recommended that "the primary objective of selected Actions be the delivery of appropriate utilisation of agricultural genetic resources in practice" and that "increased involvement of end-users and small and medium enterprises in the funded actions, to ensure the immediate transfer and implementation of project results." With regard to AnGR management specifically, the submission provided by the European Regional Focal Point on Animal Genetic Resources to the expert evaluation emphasized the opportunity that the programme provided to link "on farm" conservation activities to research activities (ERFP, 2012). It also noted that applied research under the five AnGR-related co-funded actions had contributed enormously to the sustainable management of AnGR. The weak points of the programme were considered to be the limited amount of funding available overall and the lack of continuity associated with project-based activities (ibid.).

With the aim of implementing the recommendations of the evaluation of the second Community Programme, the European Parliament, in 2013, allocated 1.5 million euros for a "preparatory action on EU plant and animal genetic resources"[31] that would review the state of genetic resources-related

[25] See web site: http://ec.europa.eu/agriculture/genetic-resources/actions/index_en.htm
[26] See web site: http://ec.europa.eu/agriculture/genetic-resources/actions/f-012/index_en.htm
[27] See web site: http://ec.europa.eu/agriculture/genetic-resources/actions/f-020/index_en.htm
[28] See web site: http://ec.europa.eu/agriculture/genetic-resources/actions/f-040/index_en.htm
[29] See web site: http://ec.europa.eu/agriculture/genetic-resources/actions/f-066/index_en.htm
[30] See web site: http://ec.europa.eu/agriculture/genetic-resources/actions/f-067/index_en.htm
[31] See website: http://ec.europa.eu/agriculture/calls-for-tender/2013-271472_en.htm

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activities in the EU and make practical recommendations for future improvements (European Commission, 2013c). The following themes were identified for inclusion in the review: "improvement of the communication between Member States concerning best practice and the harmonisation of efforts in the conservation and sustainable use of genetic resources"; "enhancing networking among key stakeholders and end-users in view of exploring marketing (and other cooperation) opportunities, such as provided by quality schemes and short supply chains"; "improvement of the exchange of knowledge and research on genetic diversity in agricultural systems"; "adaptation of breeding methods and legislation to the need of conservation and sustainable use of genetic diversity"; "contribution to the successful implementation of rural development measures concerning genetic diversity in agriculture"; "explore bottlenecks and enabling conditions for the sustainable use of genetic resources in agriculture"; and "reduction of the unnecessary administrative burden so as to provide better access to actions."

The first SoW-AnGR noted the existence of a body of EU legislation addressing various aspects of animal breeding, the main objective of which was to facilitate trade in breeding animals within the EU. A separate set of legal instruments was in place for each of the main mammalian livestock species or species groups raised in the EU (bovine, porcine, ovine and caprine, and equine) addressing a range of different aspects of the breeding process and trade in breeding animals (recognition of breeding organizations, entering in herdbooks, pedigree certificates and acceptance for breeding). For "other breeding animals" a basic directive was in place, but no implementing measures providing rules for the various above-listed elements. Another set of instruments had been put in place to regulate the import of breeding animals and genetic material from outside the EU and a single Council Decision had been put in place to regulate the operation of the INTERBULL reference centre for pure-bred breeding animals of bovine species.[32] This body of legislation was largely still in place at the time of writing (July 2014). However, proposals for the consolidation of these measures under a single regulation and directive had been prepared, with the aim of addressing, in particular, concerns about inconsistencies in the interpretation of the existing provisions by the authorities in different countries (European Commission, 2014b,c). Another issue of concern had been the "scattered" nature of the legislation, i.e. the existence of multiple of instruments addressing different species and different activities, which made the framework difficult to follow.

Access and benefit-sharing

Following the adoption of the Nagoya Protocol (see subsection on international frameworks), the EU was faced with the task of establishing dedicated legislation that would enable it to proceed with ratification and implementation. A draft regulation was developed by the European Commission (European Commission, 2012c), based on an extensive impact assessment study covering all relevant economic sectors and involving broad stakeholder consultation (European Commission, 2012d). The draft regulation covered the elements of the Nagoya Protocol that required harmonization and were better addressed at EU level – namely benefit-sharing and compliance – leaving access requirements to be considered by the individual EU Member States.

The draft regulation, together with the proposal for the ratification of the Nagoya Protocol, was presented to the European Parliament and the Council of Ministers in October 2012. The submission of the draft regulation was followed by an intensive period of discussions and negotiations between the different EU institutions involved in the legislative process. The political compromise between co-legislators – the Council and the European Parliament – on the text of a draft regulation was achieved at the end of 2013. The vote in the Plenary of the European Parliament took place in March 2014 and the Council of Ministers adopted the regulation the following month. Successful completion of the process enabled ratification of the Nagoya Protocol by the EU on 16 May 2014 and publication of Regulation (EU) No 511/2014 on 20 May. The ratification of the Nagoya Protocol by individual

[32] Further details of this body of legislation can be found in the first SoW-AnGR (pages 295–296). Texts can be accessed via the EUR-Lex website (http://ec.europa.eu/food/animal/zootechnics/legislation_en.htm).

DRAFT - NOT FOR CITATION

Member States is proceeding, in accordance with their internal procedures. The remaining step at EU level is to develop and agree on implementing acts.

The regulation sets out rules governing compliance with the Nagoya Protocol's provisions on access and benefit-sharing for genetic resources and traditional knowledge associated with genetic resources. It is based on the principle that users of genetic resources should exercise "due diligence" in ascertaining that applicable rules on access and benefit-sharing have been and are followed (Article 4). The due diligence concept, which is elaborated in the EU timber regulation (Regulation (EU) No 995/2010), contains three elements: provision of information; risk assessment; and risk mitigation. The benefit-sharing requirements of the Nagoya Protocol are to be dealt with on the basis of "mutually agreed terms" between the provider and the user.

Regulation (EU) No 511/2014 also covers compliance measures such as checkpoints (Article 7) and risk-based monitoring of users (Article 9), as well as the establishment of competent authorities and national focal points, and reporting and submission of information to the Access Benefit Sharing Clearing House.[33] It requires Member States to establish penalties in that are effective, proportionate and dissuasive. It also establishes important compliance-facilitation tools such as EU-registered collections (Article 5) and recognized best practices (Article 8).

The influence that the Nagoya Protocol will have on the management of AnGR in the EU is difficult to predict. Effects will depend heavily on the access legislation adopted by individual Member States. However, it is possible that the new arrangements will contribute to the enhancement of gene banking and the development of AnGR held in the public domain.

Animal health

The first SoW-AnGR provided an overview of the EU framework for animal health – a large body of instruments addressing various individual species, health problems and livestock-sector activities – and noted a number of potential effects on AnGR and their management. Given that animal health problems can pose a direct threat to the survival of at-risk breed populations and can undermine the economic sustainability of livestock-keeping livelihoods, a well-regulated animal health system is an important component of AnGR management in the broad sense. Potentially negative consequences include the effects of compulsory culling campaigns on at-risk breed populations and various restrictions and requirements that may constrain conservation activities or the keeping of certain breeds in their traditional production systems. The rreport noted both that some problems of this type had arisen at EU level and that some steps had been taken to address them (e.g. allowing for potential derogations for at-risk breeds in the event of a culling campaign and adjusting animal identification requirements to account for problems encountered in certain extensive production systems).

In 2008, the European Commission adopted a communication on an action plan for the implementation of a new animal health strategy for the EU for the six years to 2013 (European Commission, 2008). The strategy document, subtitled "Prevention is better than cure", noted the challenges posed by new and re-emerging diseases and by the increased volume in trade in animal products both within EU and with third countries. The strategy was based on four main pillars: "1. Prioritisation of EU intervention; 2. The EU animal health framework; 3. Prevention, surveillance and preparedness; and 4. Science, Innovation and Research" (European Commission, 2007).

With regard to regulation, the objective was to develop a "single clear regulatory framework" converging as far as possible with the standards and guidelines of the World Organisation for Animal Health (OIE)[34] and the Codex Alimentarius Commission.[35] After extensive consultations a proposal for a new regulation on animal health was published in 2013 (European Commission, 2013d), the intention being to streamline the large number of existing instruments in this field into a single law. In April 2014, the European Parliament adopted a legislative resolution containing a number of

[33] The Access and Benefit-sharing Clearing-House was established under Article 14 of the Nagoya Protocol.
[34] http://www.oie.int
[35] http://www.codexalimentarius.org/

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amendments to the draft act. These amendments featured a number of references to breed conservation and the need to maintain genetic diversity, including specific proposals that competent authorities should consider these factors when deciding upon what actions to take in the event of a disease outbreak, that (in addition to material intended for scientific purposes) material destined for inclusion in a gene bank should be eligible for potential derogations of rules related to the movement of genetic material; that the European Commission should take breed-level diversity into account when adopting delegated acts related to the approval of establishments[36] of various kinds; and that breed should be included as a data item in traceability systems for genetic material (EU, 2014d).

Organic products and other specialized food products

Supplying products to various niche markets is recognized as a potential means of keeping breeds in profitable production and thereby reducing the likelihood that they will fall out of use and face the risk of extinction (See Part 4 Section [crossref]). Niche marketing can be facilitated by the existence of a legal framework that regulates the designation and labelling of particular classes of products that have characteristics that make them attractive to particular groups of consumers.

The first SoW-AnGR noted the existence of a number of EU quality schemes that cover animal products and briefly described the legal framework established during the 1990s to regulate the operation of these schemes.[37] A new framework was put in place in 2006: Council Regulation (EC) No 510/2006 on protected geographical indications (PDI) and protected designations of origin (PDO) and Council Regulation (EC) No 509/2006 on traditional specialties guaranteed (TSG). In the case of PDIs and PDOs, the rules stated that a name could not be registered if it conflicted " with the name of a plant variety or an animal breed and as a result is likely to mislead the consumer as to the true origin of the product." The regulation on TSGs, however, stated that the "name of a plant variety or breed of animal may form part of the name of a traditional speciality guaranteed, provided that it is not misleading as regards the nature of the product." Rules related to product specification (i.e. the description of the product for the purposes of its registration under one of the quality schemes) included no references to breed-related information. As noted in the ffirst SoW-AnGR, many PDIs, PDOs and TGIs for animal products involve no requirement that the product comes from a specific breed. 2012 saw the adoption of a new unified instrument, Regulation (EU) No 1151/2012. The main innovative feature of this instrument is the establishment of a scheme for the use of "optional quality terms", the objective being "to facilitate the communication within the internal market of the value-adding characteristics or attributes of agricultural products by the producers thereof." The regulation establishes the term "mountain product" as an optional quality term and requires the European Commission to investigate the case for a new term, "product of island farming". A report setting out the pros and cons of introducing this term was published late in 2013 (European Commission, 2013e). Conditions of use for the "mountain product" quality term are further elaborated under Commission Delegated Regulation (EU) No 665/2014. The European Commission has also investigated the possibility of establishing a labelling scheme for "local farming and direct sales" (European Commission, 2013f).

The EU legal framework for organic agriculture has also been revised since the time the first SoW-AnGR was drafted. The main instrument in the current framework is Council Regulation (EC) No 834/2007, which addresses both crop and livestock production. Detailed rules for the implementation of this regulation are set out in Commission Regulation (EC) No 889/2008. Under this new framework, provisions related to the choice of breeds for organic livestock production are similar to those previously in place,[38] i.e. account must be taken of animals' capacity to adapt to local conditions. Likewise, both the 1999 and the 2007 regulations refer to the use of well-adapted breeds being a fundamental element of organic disease-control strategies. The 2007 regulation also refers to

[36] An "establishment" in this context refers to "any premises, structure, or any environment, in which animals or germinal products are kept, except for: (a) households keeping pet animals; (b) non-commercial aquaria keeping aquatic animals; (c) veterinary practices or clinics."
[37] See pages 296 to 297.
[38] Regulation (EC) 1804/1999 (see page 297 of first SoW-AnGR for further information).

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the use of well-adapted breeds as a means of avoiding the use of welfare-unfriendly practices. The provisions of the 2007 regulation that address the use of "non-organic" animals for breeding purposes, allow some additional flexibility to use such animals in the case of breeds that are at risk of extinction.

On the policy front, the European Action Plan for Organic Food and Farming, launched by the European Commission in 2004 (European Commission 2004a,b) was replaced in 2014 by the Action Plan for the Future of Organic Production in the European Union (European Commission, 2014d). The new plan aims to ensure, *inter alia*, that consumer trust and the integrity of organic production are maintained in the face of rising demand and changing societal expectations, while also avoiding overcomplicated rules that exclude small operators and maintaining the innovative role of the organic sector. It contains no specific references to the role of AnGR diversity in organic agriculture.

A legislative proposal for a new regulation (replacing that of 2007) was published by the European Commission in March 2014 (European Commission, 2014e,f). The roles of well-adapted breeds are again highlighted and the above-mentioned provision related to the use of non-organic breeding animals from at-risk breeds is maintained (in other respects, the rules regarding the origin of breeding animals for use in organic agriculture become less flexible).

The precise implications of these developments for AnGR management remain unclear. While the growth of organic production probably contributes to some degree to increasing demand for locally adapted animals – and thus keeping relevant laws and policies updated is likely to be conducive to sustainable AnGR management – in many cases, organic production is based on "mainstream" breeds widely used in conventional agriculture. Effects on the use of AnGR at national level in some EU countries are discussed below in the subsection on national legal and policy frameworks. Some criticism has been directed at the current EU framework on the grounds that allowing the widespread use of mainstream animals in organic agriculture creates welfare problems because of these animals' lack of adaptedness to more "natural" production environments (Compassion in World Farming, 2013; Eurogroup for Animals, 2013).

Animal welfare

The main EU legal instrument on the welfare of animals kept for farming purposes is Council Directive 98/58/EC. As noted in the first SoW-AnGR, this directive includes rules regarding the use of breeding procedures and regarding the need to ensure that "on the basis of their genotype or phenotype", animals "can be kept without detrimental effect on their health and welfare." Specific instruments addressing the welfare of laying hens, calves, pigs and broiler chickens are also in place. Two of these, Council Directive 2008/119/EC (calves) and Council Directive 2007/43/CE (broilers), are new since the time the ffirst SoW-AnGR was drafted. There is also a new instrument, Council Regulation (EC) No 1099/2009, addressing welfare at the time of slaughter. The main policy instrument in this field is the EU Strategy for the Protection and Welfare of Animals 2012–2015 (European Commission, 2012e). The various new laws and policies do not include any provisions specifically related to use of breeding technologies or to the circumstances in which particular genotypes can be raised.

The extent to which these various newly introduced instruments affect the management of AnGR is difficult to estimate. As production systems are adapted to meet welfare rules, demand for various types of AnGR is likely to change to some degree. More direct effects can potentially arise via bans on the use of breeds that have specific phenotypes that may affect their welfare. An interesting example of a cattle breed whose use has been the subject to legal challenges is the Belgian White Blue, which because of its double muscling phenotype has a high rate of caesarian sections (Lips et al., 2001). During the 1990s, the European Court of Justice ruled that under European zootechnical legislation (Directive 87/328/EEC) Sweden could not forbid, due to welfare concerns, the use of imported semen from this breed, on the grounds that "national authorities are not entitled to reject the use of semen of that breed … since the genetic peculiarities and defects of an animal may be defined only in the Member State in which the breed of cattle has been accepted for artificial insemination" (Case C-162/97).

DRAFT - NOT FOR CITATION

Food and feed safety

In the field of food and feed safety, the main instruments noted in the first SoW-AnGR – Regulation (EC) No. 178/2002 and Regulation (EC) No. 882/2004 – continue to form the backbone of the EU legal framework. A new regulation on the traceability of food of animal origin, Regulation (EU) No 931/2011, has been put in place. These instruments do not include any provisions specifically related to breeding or AnGR management. Effective frameworks addressing these matters are, in general, likely to benefit livestock-keeping livelihoods by promoting animal health and consumer confidence in animal products and hence may benefit AnGR diversity (in addition to their direct benefits in public health terms). However, as noted in the first SoW-AnGR, such legislation can potentially prove onerous for small-scale producers and may also create problems for the marketing of some speciality products (see subsection on national frameworks, below, for discussion of some reported examples).

2.2. Other regional frameworks

Many parts of the world have regional or subregional intergovernmental bodies that promote economic or political cooperation among member countries. In some cases, these bodies have the authority to adopt legally binding instruments. Whether or not this is the case, they normally have some policies and strategies that aim to coordinate the activities of their member countries within particular areas of activity. Outside the EU, regional legal frameworks, where they exist, are relatively undeveloped and include few instruments specifically targeting the livestock sector, with the partial exception of zoosanitary matters. It is beyond the scope of this report to present an overview of the legal and policy frameworks of all the world's regional and subregional bodies and their potential effects on AnGR management. However, some examples – mostly of policy instruments – are presented below.

Several of the subregional economic communities of Africa have developed policies that directly target AnGR management, as well as various provisions addressing the livestock sector in a broader sense. For example, in 2005, the Heads of State and Government of the Economic Community of West African States (ECOWAS)[39] adopted a regional agricultural policy referred to as ECOWAP (Decision A/Dec. 11/01/05). Livestock-related elements of the policy include plans to harmonize sanitary norms and standards and to establish a regional programme on transhumance. A decision on the use of "transhumance certificates" to regulate the cross-border movements of pastoralists had previously been adopted (Decision A/Dec5/10/98).[40] 2010 saw the publication of the Strategic Action Plan for the Development and Transformation of Livestock Sector in the ECOWAS Region (2011–2020) (ECOWAS Commission, 2010). The plan's objectives include: "Improvement of the performance of local breeds through emphasis on the following: (i) Evaluation and harmonisation of the management of genetic resources ; (ii) Facilitation of the development of regional centres of excellence and genetic value addition to local breeds as well as capacity building."

The Regional Indicative Strategic Development Plan of the Southern African Development Community (SADC)[41] for the period 2005 to 2020 includes the "sustainable management and utilization of farm animal genetic resources" among its strategies for increasing production, productivity and profitability in the livestock sector (SADC, 2003). Other relevant elements of the plan include promoting diversification and intensification of crop and livestock systems and strengthening and broadening early-warning systems for livestock diseases. None of SADC's legally binding instruments target AnGR management specifically. However, the Protocol on Trade (1996) has an annex on sanitary and phyosanitary matters (approved in 2008). The organization has taken several initiatives of relevance to AnGR management in the region, including the Promotion of

[39] Member states: Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo.
[40] See Box 65 of first Sow-AnGR (page 328).
[41] Member states: Angola, Botswana, Democratic Republic of the Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia, Zimbabwe.

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Regional Integration initiative, which operated between 2005 and 2009 with the aim of improving productivity and trade flows in the livestock sector, the Trans-boundary Animal Diseases Project and the Foot and Mouth Disease Programme.[42]

The African Union, as part of its efforts to foster agricultural development across the continent, has taken steps to promote the sustainable use and development of AnGR. For example, its framework for mainstreaming livestock into the Comprehensive Africa Agriculture Programme[43] calls for a number of actions targeting the characterization and conservation of AnGR, as well dissemination of information, technology transfer and harmonization of regulatory frameworks (AU-IBAR, 2010). The Strategic Plan 2014 to 2017 of the African Union – Interafrican Bureau for Animal Resources (AU-IBAR) addresses the implementation of the Global Plan of Action for Animal Genetic Resources in Africa (AU-IBAR, 2013). As described in the ffirst SoW-AnGR,[44] the African Union's predecessor, the Organization of African Unity, developed a model law on the protection of the rights of farmers and the regulation of access to biological resources to assist countries in the development of national policies and legislation in this field (OAU, 2000). In the wake of the adoption of the Nagoya Protocol on Access and Benefit Sharing, the African Union Commission, under its Biodiversity Programme, [45] is working to support countries in the implementation of the Protocol. A gap analysis of the model law was commissioned; the report of this analysis (Munyi *et al*., 2012) recommended the development of complementary guidelines to be used alongside the model law. [46]

In Latin America, the Andean Community of Nations[47] has put in place a number of instruments relevant to AnGR management. Decision 523 of 2002 approves the Regional Biodiversity Strategy for the Countries of the Tropical Andes. While this strategy does not include any provisions specifically addressing AnGR management, it includes a "line of action" on the conservation and sustainable use of native and locally adapted agrobiodiversity, which focuses, *inter alia*, on characterization, identifying means of stimulating the marketing and use of products and services to support *in situ* conservation, strengthening scientific and technical capacities, and addressing access and benefit-sharing issues. Decision 391 of 1996 establishes a common subregional regime for access to genetic resources. It targets all genetic resources, with no particular provisions for AnGR or genetic resources for food and agriculture in general. Other relevant instruments in this subregion include Decision 328 on agricultural and animal health.

Elsewhere in the world, regional bodies have put in place few legal or major policy instruments targeting AnGR management or that include it under broader fields of action such as livestock development or biodiversity conservation. One example of an instrument that acknowledges the significance of AnGR is the Cooperation Council of the Arab States of the Gulf's General Regulations of Environment in the GCC States (1997),[48] which states that responsibilities of agency responsible for environmental protection and conservation should include issuing and implementing rules and regulations related to, inter alia, "conservation of biological resources of local domesticated animals and local plants of economic value and improving them conservation of the environment."

2.3. Conclusions

As recognized in the Global Plan of Action for Animal Genetic Resources, many aspects of AnGR management potentially benefit from coordination and cooperation at regional level. Regional

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[42] For further information, see the SADC Livestock Production website (http://www.sadc.int/themes/agriculture-food-security/livestock-production/).
[43] The Comprehensive Africa Agriculture Development Programme was endorsed by African Heads of State in 2004. For further information, see the programme website: http://www.nepad-caadp.net/
[44] First SoW-AnGR; Box 45.
[45] Website: http://rea.au.int/en/content/biodiversity
[46] A "Validation Workshop on the AU Guidelines for a Coordinated Implementation of the Nagoya Protocol on Access and Benefit Sharing" was held in October 2013 (http://hrst.au.int/en/content/validation-workshop-au-guidelines-coordinated-implementation-nagoya-protocol-access-and-bene).
[47] Member states: Bolivia (Plurinational State of), Colombia, Ecuador, Peru.
[48] Member states: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates.

collaboration does not necessarily depend on the existence of regional-level legal and policy frameworks. However, as in many fields of activity, a lack of consistency and coordination at policy and legislative levels, has the potential to inhibit both trade in genetic resources and non-commercial collaboration in conservation, research and so on. In this respect, a regional approach that facilitates harmonization at these levels may be useful. There may also be benefits in terms of cost effectiveness if countries are spared the need individually to develop their own frameworks from scratch. On the other hand, as with laws and policies at any level (e.g. national or global), regional frameworks have the potential to overburden stakeholders with costs and bureaucratic procedures or to fail because of a lack of capacity to implement or because of poor design. Clearly, any plans to establish regional frameworks need to be well adapted to the needs and capacities of the respective regions. The example of the European Union appears to indicate that in some fields of activity legal and policy frameworks need to be overhauled quite frequently if they are to remain relevant. Another notable characteristic of developments in the EU are the wide-ranging stakeholder consultations that take place before any legal instruments are put in place.

Outside Europe, as was the case at the time of the first SoW-AnGR, regional policy and, particularly, legal instruments addressing AnGR management are few and far between. The topic appears not to have entered in any substantial way onto the agendas of many regional bodies. It is, of course, difficult without an in-depth major analysis of circumstances in the respective regions to know what the potential benefits and costs of attempting to establish instruments of this kind might be.

Assessing the effects of existing frameworks is also difficult. In the EU, assessments of the impact of AnGR-related instruments have been published and indicate various positive outcomes. However, there is some concern about a lack of involvement of the "end-users" of genetic resources and a lack of focus on utilization relative to conservation. Little has been published on the effects of regional AnGR-related policies elsewhere in the world.

Changes since the time of the first SoW-AnGR have been quite substantial in Europe. Several areas of AnGR-relevant legislation have seen major revisions, often with the aim of consolidating and clarifying frameworks that had developed into elaborate sets of species- and topic-specific instruments. In many cases, these updated frameworks have been established only recently, or still are in the process of development.[49] Their practical effects on AnGR management are therefore not yet evident. Another significant development has been the continued expansion of the EU. Ten countries had recently become members at the time the first SoW-AnGR[50] was prepared. Two more joined in 2007[51] and another in 2013.[52] Some country reports (e.g. Bulgaria and Poland) note that adapting to EU policy and legal frameworks has had – and continues to have – a significant impact on the management of their AnGR. Outside Europe, the most prominent developments have been in policy rather than legal frameworks and mainly in Africa, both at continental (African Union) and at subregional levels.

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3. National legal and policy frameworks

3.1. Roles of national laws and policies in animal genetic resources management

> *"A range of policies and legal instruments have direct or indirect effects on the use, development and conservation of animal genetic resources. These instruments often pursue different objectives, such as economic development, environmental protection, animal health, food safety, consumer protection, intellectual property rights, genetic resources conservation, and access to and equitable sharing of benefits arising from the use of animal genetic resources."*

As the quotation shows, the Global Plan of Action on Animal Genetic Resources[53] recognizes both the significant role of legal and policy frameworks in AnGR management, and the potentially complex nature of the effects involved. Laws and policies can serve as tools in AnGR management, but they also form part of the context within which AnGR management takes place. As discussed in Part 2 of this report, legal and policy frameworks are often among the factors shaping the development of a country's livestock sector.

There is no "blueprint" for an effective legal and policy framework for AnGR management. As well as having its own particular set of objectives, problems and opportunities, each country will have its own legal system and approach to the development and implementation of policies. The Global Plan of Action does not attempt to prescribe solutions or even to provide a checklist of topics that need to be addressed. However, it does call on countries to "periodically review existing national policies and regulatory frameworks, with a view to identifying any possible effects they may have on the use, development and conservation of animal genetic resources ..." and to "consider measures to address any effects identified in [the] reviews of policy and legal frameworks."[54]

Countries wishing to improve the effectiveness of their legal and policy frameworks as tools to promote the sustainable management of AnGR potentially have a number of different strategies at their disposal. For example, the Global Plan of Action notes that countries may wish to respond to any identified weaknesses in their existing provisions either via policy and legislative changes or by improving the implementation of existing measures.[55] With regard to the types of instruments required, the first SoW-AnGR tentatively concluded that, in some circumstances, attempting to develop elaborate legal frameworks may not be the best way forward. It noted the potential contribution of "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 ..."[56]

[53] Rationale to Strategic Priority 20.
[54] Strategic Priority 20, Actions 1 and 2.
[55] Strategic Priority 20, Action 2.
[56] Page 333.

DRAFT - NOT FOR CITATION

However, it also noted that some countries had reported the need to improve their legal frameworks in order to put their existing policies into operation. It also noted that some countries were increasingly relying on market mechanisms and private institutions to provide for various aspects of AnGR management and that in these circumstances close attention needed to be paid to the potential need for regulatory measures to ensure that public-goods aspects of AnGR management were adequately accounted for.

Whatever approach countries choose to take in terms of promoting or enabling effective AnGR management (i.e. whatever the balance between legislation, policy measures and reliance on the market and private initiatives), it is likely that some aspects of livestock development – and of other activities that affect livestock development – will be regulated by law and that this will affect the management of AnGR. The field of animal health and zoosanitary protection – which the first SoW-AnGR concluded was the most heavily regulated aspect of the livestock management – is perhaps the most obvious example. Increasing concerns about a number of public goods-related issues in the livestock sector (e.g. environmental protection and human public health), across ever wider areas of the world, mean that in many countries the range of livestock-sector activities subject to legal regulation may expand. Developments of this kind can present both challenges (e.g. additional regulatory burdens or restrictions on livestock keepers' activities) and opportunities (e.g. better protection from disease and environmental threats, potential new niche markets) for the management of AnGR. In some circumstances, it may be feasible to build "AnGR-friendly" provisions into legal instruments in these various fields. In others, it may be necessary to focus on policy measures that help livestock keepers and other managers of AnGR adapt to the circumstances created by the introduction of the new legislation.

3.2. Context, information sources and methodology

The broad range of potentially relevant legislation and policies, and the fact that the concrete effects of legislation and policies on AnGR management cannot necessarily be inferred simply from the wording of the respective instruments, have meant that it has been difficult to obtain a global overview of the state of national provisions in this field and their implications for AnGR. In 2003, FAO conducted a survey, in which questionnaires were sent to all National Coordinators for the Management of AnGR and the Chairs and Technical Secretaries of National Consultative Committees[57] on AnGR.[58] Combined with information obtained from all the country reports[59] that had been submitted to FAO by September 2003 and from an extensive internet search, the results of the survey were used to prepare an FAO Legal Study entitled *The legal framework for the management of animal genetic resources* (FAO, 2006). The material assembled for this study was later combined with information obtained from additional country reports, from FAO's FAOLEX database[60] and via direct e-mail contact with National Coordinators to prepare a chapter on national legislation and policy for the first SoW-AnGR.[61] Both the legal study and the first SoW-AnGR stressed that the material presented should not be regarded as a comprehensive global inventory of all relevant legal and policy instruments. The other main limitation of these studies was that, as noted above, an inventory of instruments does not necessarily provide a good indication of their effects on AnGR management – or of what needs to be done to supplement or improve them.

In 2013, as part of the preparation process for the second SoW-AnGR, FAO organized another global survey of national legal and policy frameworks (referred to below as "the legal survey"). All National

[57] These bodies were established for the preparation of country reports for the first SoW-AnGR process.
[58] The legal study reported that "In most cases, the response to the Questionnaire was prepared by the National Coordinator, or by the Chair or Secretary of the National Consultative Committee, in consultation with relevant departments of ministries and other organizations."
[59] Reports submitted as part of the first SoW-AnGR process (ftp://ftp.fao.org/docrep/fao/010/a1250e/annexes/CountryReports/CountryReports.pdf).
[60] http://faolex.fao.org/faolex/
[61] Subsection 4 of Part 3 Section E (ftp://ftp.fao.org/docrep/fao/010/a1250e/a1250e14.pdf).

DRAFT - NOT FOR CITATION

Coordinators were invited to complete a questionnaire[62] in which they were asked to indicate the presence or absence of legal and policy instruments at national level in a number of fields of action directly or indirectly relevant to the management of AnGR, to describe these instruments, to indicate the effect they (or the absence of relevant laws and/or polices) were having on AnGR management, and the country's needs with respect to the future development of its legal and policy framework. Forty-six fully completed questionnaires were submitted.[63] This provided a smaller, but more in-depth, dataset than had been available for the previous studies. The objective of obtaining detailed information on how existing instruments affect AnGR management and on countries' future priorities for the development of their legal and policy frameworks was only partially met (answers were often worded in a very general way or appeared to refer to general improvements in AnGR management rather than specifically to improvements to legal and policy frameworks). The main country-report questionnaire for the second SoW-AnGR provided countries with additional opportunities to report on their legal and policy frameworks, particularly in the section on institutions and stakeholders[64] and the section on progress in implementing Strategic Priority Area 4 of the Global Plan of Action.

For the purposes of the legal survey, a "policy" was defined as follows: "a set of planned actions adopted by government with the aim of meeting a specific objective or objectives – a policy may be approved by parliament, but is not as by intent or nature legally binding. Instruments of this type may be given a range of different names including 'strategy', 'programme' or 'plan'."[65] One of the objectives was to identify whether, how and to what extent formal instruments of this kind contribute to improving the management of AnGR relative to situations in which management actions (if any) are taken on a more ad hoc basis. The discussion that follows below also focuses on formal policy instruments. It should, however, be recognized that "policy", in a broader sense, can include the unwritten "level of commitment" shown by a government to a given field of activity, whether or not it is targeted by a specific policy instrument. It may also refer to the "stance" or attitude of a government with respect to a particular question, influencing the type of action that is taken, but not part of a conscious and coherent effort to pursue a particular outcome. The legal survey did not address the effects of policies in these more informal senses. However, the country-report questionnaire provided countries with opportunities to comment on the state of policy implementation, the state of awareness of policy-makers and constraints (of any kind, including political) to the implementation of various AnGR management activities.

For the purpose of the survey, "legislation" was taken to include "both primary legislation (e.g. laws, acts) [66] and secondary legislation (e.g. regulations)[67]". Countries were also given the opportunity to report on "relevant court cases (especially in common law systems)[68] and on trends in customary law.[69]" Little or no information on the significance for AnGR management of customary law or of

[62] http://www.fao.org/ag/againfo/programmes/documents/genetics/global/SoWAnGR_leg_policies_invitation_E.pdf

[63] 17 OECD countries: Austria, Czech Republic, Finland, France, Germany, Hungary, Italy, Luxembourg, Netherlands, Norway, Republic of Korea, Slovenia, Spain, Sweden, Switzerland, United States of America.
29 Non-OECD countries: Bhutan, Brazil, Bulgaria, Burundi, Costa Rica, Croatia, Cyprus, Democratic Republic of the Congo, Ecuador, Ethiopia, Ghana, Guatemala, Iraq, Jordan, Latvia, Malaysia, Mauritius, Montenegro, Namibia, Nepal, Serbia, Sri Lanka, Sudan, Suriname, Thailand, United Republic of Tanzania, Uruguay, Viet Nam, Zimbabwe.

[64] This section provided the material for updating Part 3 Section 1 of the first SoW-AnGR.

[65] The phrase "planned actions" was used in recognition of the fact that the mere existence of a policy does not necessarily always translate into concrete activity.

[66] Primary legislation is normally enacted by a legislative body (e.g. parliament). [Foot note is part of the original quoted text.]

[67] Secondary or implementing legislation (regulations) is subsidiary to primary legislation; it provides more detail and is issued by an authority of the executive that has been specifically authorized in a parliamentary-level law to issue regulations on the respective matter. [Foot note is part of the original quoted text.]

[68] Common law, also known as case law or precedent, is law developed by judges through decisions of courts and similar tribunals. [Foot note is part of the original quoted text.]

[69] Customary law refers to the laws, practices and customs of indigenous and local communities which are an intrinsic and central part of the way of life of these communities. Customary laws are embedded in the culture and values of a community or society; they govern acceptable standards of behaviour and are actively enforced by members of the community (http://www.wipo.int/wipo_magazine/en/2010/04/article_0007.html). [Foot note is part of the original quoted text. Full reference = WIPO. 2010. What place for customary law in protecting traditional knowledge? *WIPO Magazine*, 4 (2010): 18–20.]

DRAFT - NOT FOR CITATION

legal precedent in common-law systems was submitted in the survey responses and the topic was not pursued further.

The discussion presented below is based largely on an analysis of the results of the legal survey supplemented with material from the country reports. In the case of instruments specifically targeting the sustainable use, development and conservation of AnGR, examples drawn from FAO's FAOLEX database are also included. In a few cases, material from other sources is used to illustrate particular points that were not well covered in the survey responses. Given the time and resources available a repeat of the more extensive searches undertaken during and prior to the preparation of the first SoW-AnGR was not feasible. The discussion is divided into four main subsections:

- instruments specifically addressing AnGR management (characterization, surveying and monitoring, genetic improvement, conservation, etc., i.e. approximately the subject matter of the Global Plan of Action);
- instruments addressing various aspects of the marketing of livestock products (these instruments are not primarily concerned with AnGR management, but are highly relevant to efforts to promote sustainable use);
- instruments addressing animal health (again not specifically focused on AnGR, but a highly regulated field with substantial potential to affect AnGR management); and
- instruments addressing various general aspects of agricultural and rural development (not specifically focused on AnGR, but possibly including some AnGR-related provisions and possibly affecting AnGR management indirectly in various ways).

The discussion of each specific aspect of the legal and policy framework for AnGR management aims to provide an overview of the state of provision in the respective field (whether instruments are present, in development or non-existent), to present some examples of existing provisions, to draw attention to any gaps and weaknesses that countries report in existing frameworks and to summarize available information on countries' priorities for future developments. Where necessary, a short introduction to the topic and the main types of instrument that are likely to be relevant is included. In the case of instruments directly targeting the management of AnGR (the first main subsection below) an attempt is made to present a quantitative analysis of the state of provision. It should be borne in mind that the figures presented are based purely on countries' responses to the legal survey and are therefore likely to be affected by differences in how the questionnaire was interpreted (e.g. in terms of precisely what kind of instrument qualifies for inclusion in which field of AnGR management). Time and resources did not allow for a round of reviewing that might have helped ensure a more consistent approach. It should also be borne in mind that, given the complexity of many aspects of AnGR management, the presence of an instrument addressing a given field does not necessarily indicate that there are no significant gaps in existing provisions.

Because of the relatively small number of survey responses received, the quantitative results presented below are not broken down by region as was done for the equivalent chapter in the first SoW-AnGR. However, to give an indication of differences between developed and developing countries, results for OECD (Organisation for Economic Co-operation and Development) and non-OECD countries are presented separately. The sample includes 17 OECD countries (50 percent of all OECD countries) and 29 non-OECD countries (20 percent of all non-OECD members of the CGRFA). Given that member countries of the European Union are subject to regional-level legal and policy frameworks in many relevant fields (see above), these countries are treated as a distinct subgroup in some of the textual descriptions. However, separate quantitative analyses are not presented for this group of countries.

The legal survey respondents were a self-selecting group that included approximately 35 percent of all the countries that submitted country reports.[70] The country-report questionnaire did not include detailed questions about legal policy frameworks. However, it required countries to provide a score (none, low, medium or high) for the state of their legal and policy frameworks for AnGR management

[70] Only one country (Australia) submitted a response to the legal survey but provided no country report.

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(see Part 3 Section 1 [crossref]). Comparing the average scores of the survey respondents to those of the full set of countries that submitted country reports provided an opportunity to roughly evaluate how representative the subsample was with respect to the state of policies and legislation. As might have been expected, the survey respondents scored, on average, higher than did the full set of countries. In the case of OECD countries, the survey respondents scored on average 17 percent higher than the full sample for both legislation and policies. [71] The equivalent figures for non-OECD countries were 6 percent higher in the case of legislation and 15 percent higher in the case of policies.[72]

The choice of examples presented below, both in the main text and in boxes, is influenced to a large extent by the availability of information. However, the aim is to provide some geographical diversity, at least in terms of developing vs. developed countries. The focus is also, as far as possible, on instruments that include a substantial body of AnGR-focused provisions or have some clearly identifiable effect on AnGR management. It must, however, be emphasized that the examples presented are intended as illustrative instances of the kinds of instruments that countries have put in place. They are not necessarily typical of instruments in the respective field. They are also not intended as examples of "best practice", and the mention of an instrument is not intended to imply that it is superior to equivalent provisions in other countries.

3.3. Instruments targeting the management of animal genetic resources

Overall management of animal genetic resources

As awareness of the importance of AnGR has increased at policy level in recent years – particularly since the adoption of the Global Plan of Action in 2007 – a growing number of countries have recognized the need for a more coherent national approach to the management of their livestock biodiversity. In some cases, this was an explicit conclusion of the country report prepared during the preparation of the first SoW-AnGR. For example, the country report of the United Kingdom states that "The creation of a National Action Plan, facilitated through the National Co-ordinator, for the conservation and utilisation of AnGR in the UK based on the recommendations in this Report is strongly recommended." The recommendation was followed up in 2006 with the publication of the UK National Action Plan on Farm Animal Genetic Resources.[73]

The Global Plan of Action itself recognizes the importance of adopting a "strategic planning approach to conservation and utilization strategies" that identifies priorities at (*inter alia*) national level.[74] In 2009, the CGRFA endorsed guidelines on the preparation of national strategies and action plans for AnGR (FAO, 2009a) and encouraged countries to make full use of them (FAO, 2009b). The guidelines emphasize the importance of obtaining government endorsement for national strategies and action plans, i.e. that it is important for these instruments to become formal national "policies" in the sense described above (although the guidelines also recognized that the most appropriate approach to obtaining governmental commitment will vary from country to country).

Twenty-five percent of the countries that submitted country reports indicated that they have government-endorsed national strategy and action plans (NSAPs) in place. A further 4 percent

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[71] Out of a possible maximum score of 3, OECD legal survey respondents scored 2.69 on average for the state of their legislation (90 percent of the potential maximum) compared to an average score of 2.30 (77 percent) for all OECD countries in the full country report dataset. The equivalent figures for policies were, by coincidence, exactly the same.
[72] Out of a possible maximum score of 3, non-OECD legal survey respondents scored on average 1.31 (44 percent of the potential maximum) compared to 1.23 (41 percent) for all non-OECD countries in the full country report dataset. The equivalent scores for polices were 1.59 (53 percent) and 1.38 (46 percent).
[73] Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69397/pb12190-fangr-actionplan.pdf
[74] Paragraph 16.

reported that their NSAPS have been prepared, but are not yet government endorsed, and 24 percent reported that they are in the process of preparing NSAPs.

As part of the legal survey, countries were asked about legislation and policy instruments targeting the "overall management of AnGR".[75] A large majority of responding OECD countries (76 percent) indicated that they have developed policies in this category. The figures for non-OECD countries were substantially lower (34 percent). However, a further 55 percent of non-OECD countries reported that they are in the process of developing policies of this type.[76] While many countries have chosen to develop AnGR-specific national strategies and action plans, some survey responses indicate that AnGR-related issues are addressed via national biodiversity strategies and action plans (i.e. instruments covering all types of biodiversity) (e.g. France),[77] via strategies for agricultural biodiversity as a whole (e.g. Italy)[78] or as part of a broad livestock-development policy or strategy (e.g. the United Republic of Tanzania).[79] The potential advantage of such an approach is that AnGR management may be better integrated into broader development strategies. The potential disadvantage is a lack of sufficiently detailed attention to AnGR and possibly a lack of sufficient "visibility" for AnGR-specific issues among policy-makers and the general public. The question of how AnGR management is addressed in legal and policy instruments addressing broader issues in rural development and environmental protection is discussed in more detail below.

In cases where the survey responses highlight problems associated with the lack of an overarching national policy for AnGR management, the main concern is a lack of coordination among different policy initiatives. In the words of the response from Iraq, for example, AnGR-related work "is scattered and not organized." Similarly, the response from Bhutan states that "since there are no overall policy directives, different agencies are promoting their own mandates. For example, Agency A promotes exotic high-yielding breed X in an area with traditional breed Y to increase production, while Agency B says breed Y has to be conserved ...[C]onservation and management of ... traditional breeds are less effective under such circumstances."

Where legislation is concerned, 76 percent of OECD countries and 48 percent of non-OECD countries reported that they have legislation targeting "overall" management of AnGR (Figure 3E1).[80] Again, a substantial proportion of non-OECD countries report that they have instruments under development. While it is possible to speculate that a single broad-scope instrument might help to promote a more cohesive approach, few if any survey responses mention any specific problems associated with the lack of an instrument of this kind. Evidence from the country reports suggests, on the other hand, that some countries regard the development of a more comprehensive legal instrument as an important priority. Hungary's country report, for example, makes several references to the objective of developing a new "Animal Breeding Act" that would address a wide range of different aspects of AnGR management.[81] Slovakia's country report, in describing the main constraints to improving the sustainable use and development of its AnGR, states that "the priority is to adopt legislation ... that

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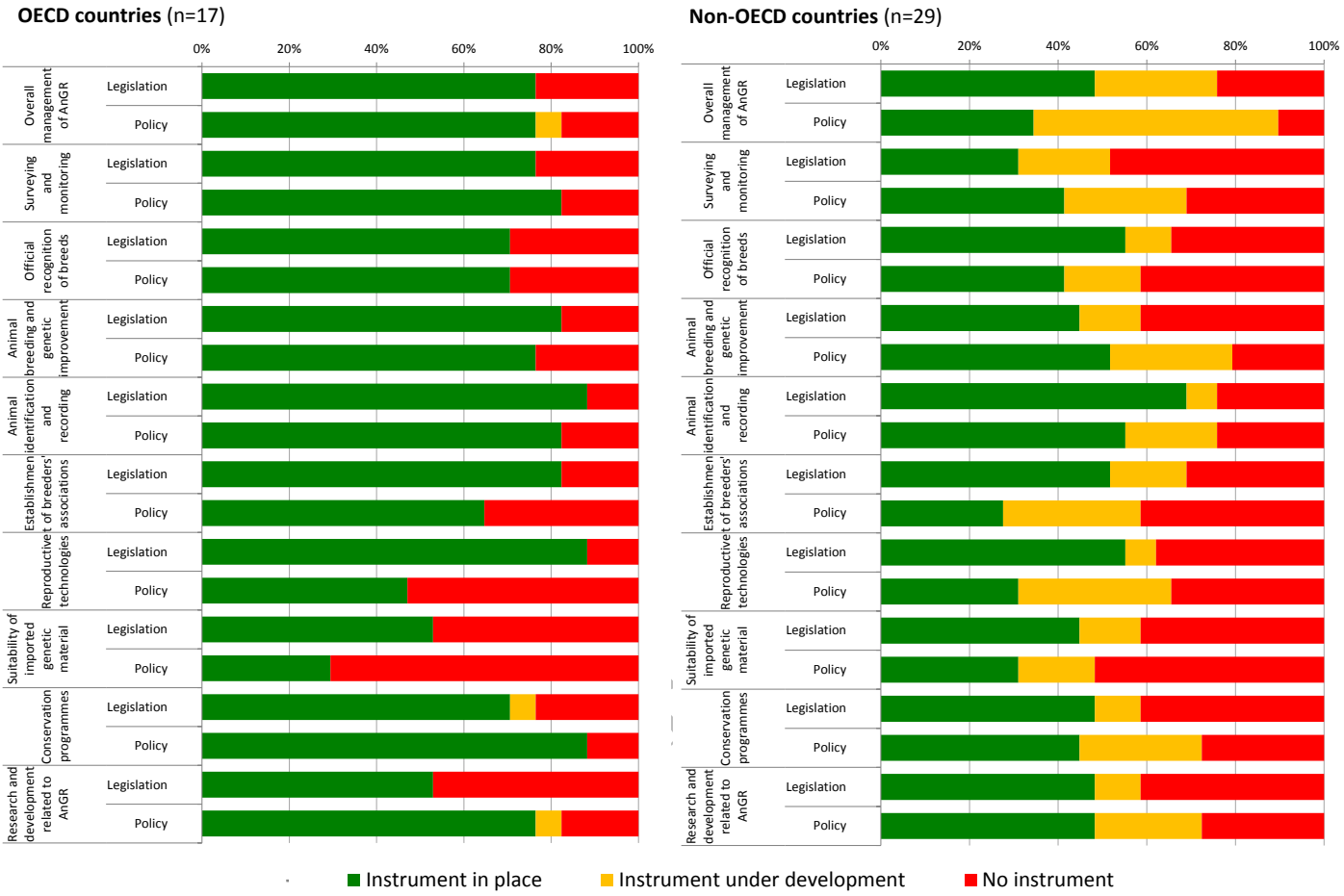
[75] The intention was to obtain information on national strategies and action plans (which were specifically highlighted as an example in the footnote to the question) or equivalent policy instruments and on legal instruments of a similar broad scope.
[76] The equivalent figure for OECD countries is 6 percent, i.e. one additional country.
[77] National Biodiversity Strategy 2011–2020 (available in English at http://www.cbd.int/doc/world/fr/fr-nbsap-v2-en.pdf).
[78] Piano Nazionale sulla Biodiversità di Interesse Agricolo (available in Italian at http://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/1225).
[79] National Livestock Policy (available at http://www.tnrf.org/files/E-INFO_National_Livetock_Policy_Final_as_per_Cabinet_Dec-2006.pdf).
[80] Some of the responses refer to a number of different instruments addressing different aspects of AnGR management rather than strictly to a single instruments that aim to create a legal framework for multiple aspects of AnGR management.
[81] The country's current legal framework is based on the Law on Animal Breeding (1993/CXIV) (available in Hungarian at http://njt.hu/cgi_bin/njt_doc.cgi?docid=19614.243848).

will treat farm animal genetic resources comprehensively" – adding that this would require amendment of the existing Animal Breeding Act[82] and the introduction of relevant regulatory decrees.

Figure 3E1. The state of development of legal and policy instruments in the field of AnGR management



Among the instruments described in the responses to the legal survey, one of the more comprehensive in its scope is Spain's Royal Decree 2129/2008, which established the country's National Program for the Conservation, Improvement and Promotion of Livestock Breeds. [83] A policy document, the Development Plan of the National Program for the Conservation, Development and Improvement of Livestock Breeds, followed in 2009. [84] The principles underlying the "joined-up" approach to national AnGR management taken in this decree are set out in its preamble: "While the need to characterize and conserve animal genetic resources has become a priority, this conservation must be linked to the selection of breeds that start from a better situation in terms of their census population size and productivity, and, in whatever case, to their sustainable use"; it further states that it is the

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[82] Act on breeding of livestock (1998) (available in Slovak at http://faolex.fao.org/docs/pdf/slo94705.pdf) amended by Act amending and supplementing the Act on breeding of livestock (2009) (available in Slovak at http://faolex.fao.org/docs/pdf/slo94706.pdf).

[83] Real Decreto 2129/2008, de 26 de diciembre, por el que se establece el Programa nacional de conservación, mejora y fomento de las razas ganaderas. *Boletín oficial del Estado*, Núm. 23 Martes 27 de enero de 2009 Sec. I. Pág. 9211 (available in Spanish at http://www.boe.es/boe/dias/2009/01/27/pdfs/BOE-A-2009-1312.pdf and in English at http://www.magrama.gob.es/es/ganaderia/temas/zootecnia/razas-ganaderas/publicaciones-interes/Real_Decreto_Ingles_tcm7-306039.pdf).

[84] Available at http://www.faeca.es/files/Sector%20ganadero/Cuestiones%20generales/Plan%20de%20desarrollo___%20Color1.pdf

"competency and responsibility of the public administration to implement effective regulation and planning of the [management of the country's] genetic heritage ..."

Other reported instruments targeting that target multiple aspects of AnGR management include France's Law on Agricultural Orientation (2006)[85] and Germany's Animal Breeding Act (2006).[86] The survey responses did not include many examples of broad-scope legal instruments from outside Europe. However, a search of FAO's FAOLEX legal database revealed a number of instruments, from various parts of the world, that target genetic improvement programmes but also include measures related to conservation (and to varying degrees other aspects of AnGR management). Examples (including additional examples from Europe) include Decree No. 2010-106 Regulating the Improvement of Domestic and Domesticated Animals in Madagascar,[87] Kyrgyzstan's Law on Pedigree Stockbreeding (2009),[88] Hungary's Decree No. 93 of (VII. 24.) concerning the Genetic Resources Conservation System of Protected Autochthonous Animal Species (2008),[89] Viet Nam's Decision No. 10/2008/QD-TTg approving the Strategy on Animal Breeding Development up to 2020 (2008)[90] (see Box 3E5) and Order No. 04/2004/L-CTN promulgating the Ordinance on Livestock Breeds (2004),[91] Poland's Act on Livestock Breeding (2007) (see Box 3E10) ,[92] Albania's Law on Livestock Breeding (2005) (see Box 3E3) ,[93] the Stock-breeding Law of the People's Republic of China (2005),[94] Uganda's Animal Breeding Act (2001),[95] Kazakhstan's Law No. 278-1 on Pedigree Stockbreeding (1998),[96] Uzbekistan's Law No. 165-I on Pedigree Stockbreeding (1995),[97] the Russian Federation's Federal Law No. 123-FZ on Pedigree Stockbreeding[98] and Ukraine's Law No. 3691-XII on Pedigree Stockbreeding (1993).[99] Another recent example is the Punjab Breeding act of 2014 (Pakistan) (see Box 3E3).

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[85] Loi n° 2006-11 d'orientation agricole (available in French at http://faolex.fao.org/docs/texts/fra67797.doc).
[86] Tierzuchtgesetz. *Bundesgesetzblatt*, Part I, No. 64, 27 December 2006, pp. 3294–3315 (available in German with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=053285&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[87] Décret N°2010-106 du 2010/03/02 réglementant l'amélioration génétique des animaux domestiques et domestiqués à Madagascar (available in French at http://faolex.fao.org/docs/pdf/mad131582.pdf).
[88] Закон Кыргызской Республики о племенном деле в животноводстве Кыргызской Республики (available in Russian with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=132067&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[89] 93/2008. (VII. 24.) FVM rendeleta védett őshonos állatfajták genetikai fenntartásának rendjéről (available in Hungarian with and abstract in English at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=127606&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[90] *Công Báo* Nos. 75-76, 27 January 2008, pp. 26–33 (available in English at http://faolex.fao.org/docs/pdf/vie79311.pdf).
[91] *Công Báo* No. 16, 24 April 2004, pp. 20–30 (available in English at http://faolex.fao.org/docs/pdf/vie45179.pdf).
[92] Ustawa o organizacji hodowli i rozrodzie zwierzat gospodarskich (available in Polish with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=071132&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[93] Ligj Nr.9426, datë 6.10.2005 për mbarështimin e blegtorisë (available in Albanian with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=053892&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[94] Available in English at http://faolex.fao.org/docs/texts/chn61879.doc
[95] Available in English at http://faolex.fao.org/docs/pdf/uga119210.pdf
[96] Закон Республики Казахстан от 09.07.1998 N 278-1 "О племенном животноводстве" (available in Russian with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=053460&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[97] Закон Республики Узбекистан «О племенном животноводстве» 21 декабря 1995 г. N 165-I (available in Russian with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=059128&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[98] Федеральный Закон Российской Федерации о племенном животноводстве (available in Russian with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=019405&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).
[99] Закон України про племінну справу у тваринництві (available in Ukrainian with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=046876&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).

Box 3E2. Albania's Law No. 9426 on Livestock Breeding

Albania is a country where the agricultural sector, and livestock production in particular, contributes significantly to the economy (18 percent of GDP). The experience of the past 24 years of development under free-market conditions (1990 to 2014) has shown that the lack of an adequate legal framework is among the main factors constraining the effective management of the biodiversity and that this has negative consequences for rural development.

The main legal instrument addressing animal genetic resources (AnGR) is Act No. 9426 of 20 January 2008 on Livestock Breeding,[100] which provides a framework for the conservation, evaluation and sustainable use of AnGR and of associated knowledge and technologies. In particular, it addresses methods and technologies for animal breeding and feeding, conservation and sustainable use of AnGR (including specific provisions for autochthonous/native/local breeds), criteria for the preparation and approval of breeding programmes, the provision of professional services related to livestock production, the establishment and administration of gene banks, the operation of breeders' associations and trade in breeding materials.

Although this law is considered an important step towards meeting international standards in the conservation and sustainable economic use of AnGR, its implementation is difficult because of a lack of human and infrastructural capacities. The objective for the medium term should be to complete the legislative framework for AnGR management in accordance with obligations deriving from the international conventions and agreements that Albania has ratified and to bring national legislation into line with international and European Union law. In particular, there is a need to elaborate the secondary legislation needed to implement in situ and ex situ conservation programmes, establish a national gene bank and a national agency for AnGR, and address property rights in light of the Nagoya Protocol on Access and Benefit-Sharing.

Provided by Kristaq Kume, National Coordinator for the Management of Animal Genetic Resources, Albania.

Box 3E3. The Punjab Livestock Breeding Act 2014 (Pakistan)

Pakistan has rich diversity of indigenous animal genetic resources (AnGR). Of the major livestock species, there are five breeds of buffaloes, 15 of cattle, 25 each of sheep and goats, 20 of camels and five of indigenous chickens. Documentation of breeds and production systems is weak. Attempts are being made to create awareness regarding the importance of AnGR and the need to improve their utilization.

Pakistan is home to world famous *Bos indicus* breeds of cattle, namely Sahiwal and Red Sindhi. Cross-breeding with exotic Holsteins and Jerseys is threatening these breeds. Establishing the Research Centre for Conservation of Sahiwal Cattle has helped to conserve the Sahiwal breed. Attempts to import Saanan and Boer goats can harm the locally adapted goat breeds. Prior to 2014, there was no legislation in place to stop unabated production (and import) of semen for artificial insemination. No certification/approval was required to produce semen locally. Semen from Sahiwal cattle and Nili-Ravi buffalo was produced in millions of doses without any attention to quality and genetic potential. It was felt that legislation was needed in order to improve the unique locally adapted breeds and to stop indiscriminate cross-breeding. A breeding policy, formulated in 2003 had not been adopted and legislation was needed to implement it. It took almost a decade, and a lot of consultation among different stakeholders, to reach this stage.

The Punjab Livestock Breeding Act 2014[101] was published on 29 May 2014. The objective of this act is to regulate livestock breeding services in the province of Punjab. It necessitates the formulation of an authority to regulate the provision of breeding services and to raise awareness regarding the need

[100] Available in Albanian with an abstract in English at http://faolex.fao.org/cgi-bin/faolex.exe?database=faolex&search_type=query&table=result&query=ID:LEX-FAOC069501&format_name=ERALL&lang=eng

[101] Available at http://punjablaws.gov.pk/laws/2567.html

to conserve and improve the genetic potential of livestock breeds. It will encourage pedigree and performance recording and the development of herdbooks by breed societies. Semen production and distribution, artificial insemination services and the import of semen will operate under set regulations. Breed societies and promotional activities for the conservation of breeds will be supported. Awareness about the Punjab Livestock Breeding Act 2014 is likely to create new breed societies. Other provinces are likely to follow the example of Punjab province, as they also have unique genetic resource to conserve and develop. If properly implemented, this will bring about a paradigm shift in the utilization of indigenous AnGR in the country. Periodic review of the implementation mechanism will be required, so that any adjustments needed to ensure the conservation and development of indigenous breeds can be made.

Provided by M. Sajjad Khan.

Box 3E4. Viet Nam's legal framework for animal genetic resources management

Close to 70 percent of the Vietnamese population live in rural areas, and 80 percent of this group practise animal husbandry. In total, animal husbandry accounts for 18 to 25 percent of the country's agricultural GDP. The current challenges facing animal husbandry in Viet Nam include unplanned, unsustainable growth in small-scale and sporadic production; low productivity, low quality and low production yields, resulting in uncompetitive products at high prices; lack of land zoned for agricultural purposes by the government; lack of investment; and lack of systematic organization of livestock services and management.

Legal instruments have been introduced in order to orient and develop goals for the livestock industry. These instruments facilitate specific plans for the provision of personnel, facilities, investment, zoning and general development, in order to combat the aforementioned challenges. The current strategy for the livestock sector encourages the development of commercial, industrial and commodity farms in which production and processing are better controlled. Food sanitation and security at national level are priorities.

The Ordinance on Livestock Breeds, passed in April 2004 to take effect in July 2004, was originally drafted and approved with foreign, imported breeds in mind. The genetic improvement objectives addressed in this instrument are chiefly to create advantageous cross-breeds of exotic and indigenous breeds (Article 5.1) through characterization and selective research (Article 11), while conserving local breeds (Article 12). The first two objectives are manifested in a number of breeding programmes: for example, Sindhi crossed with local yellow cattle; Landrace and Yorkshire crossed with local pig breeds. However, it was not until 2008 that more attention was paid to the objective of conserving indigenous breeds.

Decision No. 10/2008/QD-TTg approving the Strategy on Animal Breeding Development up to 2020 was first drafted by the Ministry of Agriculture and Rural Development. A survey was sent to authorities in all 64 provinces, as well to as to livestock specialists and experts. Amendments were then made and passed at interdepartmental and interministerial conferences. The Decision was finally completed and presented to the government for approval.

Since its inception in 2008, the Decision has improved awareness of the role of livestock at national and local levels. Most provinces have put forth development plans for livestock production. Output of livestock products has increased by 25 to 30 percent, thanks to higher breed productivity, better disease control and more environmentally sustainable practices.

Through the creation and implementation of this Decision, we have learned that in order for a legal instrument to be relevant to farmers' lives, strategy building must begin from real demands and needs. Goals and targets must have realistic timelines. Collaboration between stakeholders, government officials and NGOs is essential.

Areas that need improvement include more exhaustive and better-reinforced policies regarding the inclusion of indigenous breeds in breeding programmes. Awareness training for key stakeholders, especially policy-makers and governmental agencies, would help prevent near-sighted execution of relevant ordinances and potential oversights in regional policy-making. Collaboration and consultation with researchers and breed experts should also be instrumental in future policies.

Provided by Le Thi Thuy, National Coordinator for the Management of Animal Genetic Resources, Viet Nam.

Examples from FAOLEX of instruments relating to the establishment of institutions responsible for AnGR management include Poland's Regulation Establishing Institute Entitled to Coordinate Activities Concerning Protection of Genetic Resources of Livestock (2008)[102] and Argentina's Resolution No. 693/2004 Creating the National Advisory Commission for Genetic Resources for Food and Agriculture.[103] The legal basis for Turkey's institutional framework is described in Box 3E6. An interesting comment on the link between legal and institutional frameworks is provided in the country report from Cameroon, which states that "the major impediment to implementation of [AnGR-related legislation] lies in the conflicts that arise due to their dispersal in different ministries, namely Livestock, agriculture, Environment and forestry. Harnessing these laws and attributing their implementation and monitoring to a single National Competent Authority will greatly improve the situation."

Having listed a number of existing instruments, it is important to note that some countries have deliberately chosen to adopt a light touch with respect to national-level coordination of AnGR management strategies. In the United States of America, for example, breed development strategies are left in the hands of the private sector. Government involvement, in AnGR management is focused largely on cryoconservation and assessing the status of genetic diversity (the country's response to the legal survey notes that the establishment of its National Animal Germplasm Program was enabled by legislation[104] passed in 1990). As another example, Australia's response to the legal survey reports no legislation within the category "overall management of AnGR." It notes that "Australian Government policy on management of genetic resources is to create the enabling environment to allow both owners and users of animal genetic resources to establish breeding and conservation programs for their respective industries." The main mechanisms involved are reported to be "industry-government partnerships [that] collaborate through R&D [(research and development)] activities to determine future priorities for these industries and through these, the appropriate conservation, use and development of animal genetic resources." With regard to the significance of legal measures relative to policy measures, it is interesting to note the following statement from Ireland's country report: "Traditionally, laws were enacted in this area, but over the last 20 years policies developed by the sector have been the main drivers."

Box 3E5. The legal basis for Turkey's AnGR management programme

Turkey's National Consultative Committee on Conservation of Animal Genetic Resources and its Animal Breed Registration Committee were established on the basis of the country's Regulation on the Conservation of Animal Genetic Resources and its Regulation on Animal Breed Registration (both based on the Veterinary Services, Plant Health, Food and Feed Act of 2009).[105] The former of these two Committees is charged, *inter alia*, with identifying objectives and drawing up policies related to the conservation, sustainable utilization and characterization of AnGR and import and export of genetic material (Government of Turkey, 2011).

[102] Rozporzadzenie w sprawie podmiotu upowaznionego do realizacji dzialan w zakresie ochrony zasobow genetycznych zwierzat gospodarskich. *Journal of Laws*, 2008 No. 108 Pos. 691 (available in Polish with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=071230&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).

[103] Resolución Nº 693/2004 – Créase la Comisión Nacional Asesora en Recursos Genéticos para la Alimentación y la Agricultura (CONARGEN) (available in Spanish at http://faolex.fao.org/docs/texts/arg121919.doc).

[104] Food, Agriculture, Conservation, and Trade Act of 1990. Provisions related to the National Genetic Resources Progam were amended by the Agriculture Act of 2014 (available at http://agriculture.house.gov/sites/republicans.agriculture.house.gov/files/pdf/legislation/AgriculturalAct2014.pdf).

[105] *Law On Veterinary Services, Plant Health, Food and Feed; Law No: 5996; Adoption Date: 13/6/2010 (available in English at http://faolex.fao.org/docs/pdf/tur106155E.pdf). Similar provisions had been established under the Animal Improvement Act (No. 4631) of 2001 (available in Turkish at http://faolex.fao.org/docs/texts/tur24242.doc).

DRAFT FOR CIRCULATION NOT FOR CITATION

The primary legislation (the 2009 Act) addresses a wide range of topics spanning crop and animal agriculture and consumer protection, and is implemented by a large number of regulations in addition to those specifically related to AnGR. The Act itself includes an article on "zootechnics", which in its detailed provisions focuses largely on the operation of herdbooks and the registration of breeding animals, but which also states that "The Ministry [of Agriculture and Rural Affairs] shall take measures to protect animal genetic resources, and implement these measures or ensure that they are implemented."

Integration of AnGR management with other sectors of genetic resources for food and agriculture

As part of the legal survey, countries where asked whether they had any legal or policy instruments in place that specifically address the integration of AnGR management with the management of other genetic resources for food and agriculture. Such measures might, for example, aim to promote efficiency in the operation of genetic resources management programmes across sectors or to promote greater attention to ecological interactions between livestock and crop plants, forest trees, micro-organisms, aquatic species and so on.

Among OECD countries, in the case of both policies and legislation, 65 percent of respondents reported that they have instruments of this type in place. In the case of non-OECD countries, the figures were substantially lower (14 percent and 41 percent respectively for legislation and policy instruments). However, a number of countries reported that they have instruments under development (13 percent for legislation and 24 percent for policy instruments).

While the practical effects on AnGR management are not always clear, a number of countries provide examples of policies, strategies or institutions that, in one way or another, span several sectors of genetic resources. Austria, for example, describes several policy instruments, including the Austrian Agri-Environmental Programme (ÖPUL) and Initiative Agriculture 2020,[106] that target all aspects of agriculture (including management of AnGR) in an integrated way, taking ecological and social factors into consideration. The aim – it is reported – is to strengthen "a sustainable farm-based agriculture and forestry", within which sustainable management of AnGR is integrated. Other reported examples from Europe include Norway's National Strategic Plan of the Norwegian Genetic Resources Centre, which addresses livestock, crops and forest trees. The response from Germany notes that AnGR are considered in the country's National Agro-Biodiversity Strategy and National Rural Development Policy, and also mentions the importance of integrating the management of livestock with grassland management.

Reported examples from developing countries include Malaysia's National Strategies and Action Plans for Agricultural Biodiversity Conservation and Sustainable Utilization (strategies for plant, livestock, arthropod and microbial genetic resources published together in one document), which "strive for coordinated and holistic ways to identify, conserve and optimize the use of agricultural biodiversity in Malaysia".[107] The response from Brazil mentions that over the last decade the country's Ministry of Agriculture has been promoting integrated crop–livestock–forestry systems, which, it reports, have contributed to reducing the amount of deforestation and greenhouse gas emissions associated with livestock production. It further notes that there is no specific legislation related to this activity, but that it has taken place within the framework of the country's Forestry Code,[108] which was revised in 2010.[109] Nepal (which is in the process of developing instruments in this field) highlights links to the management of pastures and forests: "programs on conservation and

[106] http://www.lebensministerium.at/en/initiatives/Agriculture2020.html
[107] The quotation is taken from the preface of the document (which is available at http://www.fao.org/Ag/AGAInfo/programmes/documents/genetics/country_reports/Malaysia_NSAP_Oct2013.pdf).
[108] Lei n. 4.771, de 15 de setembro de 1965. Institui o novo Código Florestal (available at http://faolex.fao.org/docs/texts/bra12382.doc).
[109] Lei nº 12.651, de 25 de maio de 2012. Dispõe sobre a proteção da vegetação native (available at http://faolex.fao.org/docs/pdf/bra113357.pdf).

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promotion of farm animal genetic resources are tied up with the fodder, pasture and leasehold forestry programs …From the fiscal year 2013/14, the Government of Nepal has launched the forage pasture mission which also focuses [on] programs to conserve native animals as well as to increase the production and productivity of farm animals."

Surveying and monitoring

As discussed in Part 4 Section [crossref], establishing a national breed inventory and monitoring changes in the size and structure of breed populations are important elements of national AnGR management. As discussed in Part 3 Section [crossref], countries vary greatly in their capacities to implement surveying and monitoring activities and in terms of their specific objectives for data collection. The tasks that need to be addressed by policy and legal frameworks in this field will thus vary from country to country. Nonetheless, given the need to assemble, store and report national-scale data in a consistent way over an extended period of time, some degree of leadership and coordination at national level is likely to be essential.

FAO's guidelines on *Surveying and monitoring of animal genetic resources* (FAO, 2011) recommend that countries should review their requirements for data and information on AnGR and draw up strategies for meeting these requirements. The guidelines also note the importance of a "mandate" for national surveying and monitoring activities, i.e. that these activities should have "official status and backing from the relevant authorities." They further recommend that the key elements of such a mandate should include a definition of the objectives and scope of the activities (species and geographical coverage, time frame), allocation of responsibilities to organizations and individuals (including responsibility for coordinating and overseeing the strategy), provisions related to stakeholder involvement, and provisions related to accessing and using the data collected.

Among responses to the legal survey, 76 percent of OECD countries reported that they have policy instruments in place in this field and 82 percent that they have legislation (Figure 3E1). The figures for non-OECD countries were 41 percent for policies and 31 percent for legislation. A substantial number non-OECD countries report that they are in the process of developing legislation (21 percent) and/or policies (28 percent) in this field. Several other countries mention that they regard the development of legislation and/or policies in this field as an important objective.

Survey responses from a number of European countries (e.g. Austria and the Netherlands) note that national implementation of EU regulations on animal registration facilitate the monitoring of breed population sizes. The usual pattern in EU countries is for monitoring programmes to be based on the involvement of breed societies. The societies keep track of demographic trends in their respective breeds and provide data to a central authority that operates a database of some kind. The legal and policy frameworks for such programmes vary from country to country, but in all EU countries they are underpinned by legislation on animal registration and on the operation of breed societies. Some countries have legislation in place that explicitly allocates the task of operating a monitoring programme to a particular national body. In other cases, monitoring programmes have been established or strengthened through policy measures without recourse to specific legislation. While most survey responses from EU member countries do not mention any future needs in terms of improving legal or policy frameworks in this field, there are some indications that further strengthening is required. For example, Germany mentions the need to establish a specific regulation on monitoring. The country report from Slovakia lists a lack of "legislation concerning the responsibility of individual institutions" as one of the main obstacles to the implementation of surveying and monitoring programmes. Among countries from other parts of Europe, Norway notes the need to establish monitoring systems for species that currently lack adequate recording systems at breed level, but states that this needs to be addressed more at policy than at legislative level.

Survey responses from developing countries provide little detailed information on the nature of their existing or planned legislation and policies in this field, on the impacts of existing measures or on any steps that need to be taken to improve them. However, several countries note the practical difficulties involved in implementing their existing instruments. One objective mentioned by several countries (e.g. Brazil, Costa Rica and Sri Lanka) is to have breed-level data collection included in national

DRAFT - NOT FOR CITATION

livestock censuses. A search of the FAOLEX database did not reveal many examples of legal instruments from non-OECD countries that specifically address surveying and monitoring. Where instruments are in place, the main objective appears to be to establish institutional responsibilities. For example, China's above-mentioned Stock-breeding Law of 2005 allocates responsibility "for organizing the investigation of livestock and poultry genetic resources, releasing national reports about the status of livestock and poultry genetic resources and publishing the list of livestock and poultry genetic resources approved by the State Council" to the stockbreeding and veterinary administrative department of the State Council. Cameroon's Decree No. 2012/382 of 2012 on the organization of the Ministry of Livestock, Fisheries and Animal Industries[110] charges the Insemination and Animal Genetic Resources Service with inventory of AnGR and the identification of breeds that are at risk of extinction.

Official recognition of breeds

Given that the breed is generally the main unit of management in national AnGR management programmes, some kind of procedure (formal or informal) whereby a livestock population can be officially recognized as a breed by the national authorities is likely to be necessary, if only for matters such as international reporting on the state of AnGR diversity. Countries may also wish to establish procedures for the allocation of breeds to categories such as "native", "locally adapted" and "exotic." While formal mechanisms and strict criteria are not necessarily required, if recognition as a breed (or as belonging to a particular category of breed) affects how a livestock population is treated under national laws and policies (e.g. eligibility for support payments under conservation schemes), clear legal definitions of the criteria and processes involved may be important.

Seventy-one percent of OECD countries that responded to the legal survey reported that they have legislation in place addressing the question of the official recognition of breeds (Figure 3E1). The same proportion reported that they have policies. The figures for non-OECD countries were 55 percent and 41 percent, respectively. It should, however, be noted that the reported legal instruments are quite diverse in terms of how prescriptive they are and the extent to which they grant a role to the national authorities. For example, the response from Australia (as noted above, a country that relies mainly on the private sector and civil society organizations [CSOs] to manage its AnGR) refers to the country's Competition and Consumer Act (2010)[111] rather than to any AnGR-specific legislation and notes that the recognition of breeds is the responsibility of breed societies.

Several survey responses from European countries indicate that clearly defined criteria and/or procedures for the recognition of breeds are set out in laws or regulations. The response from Slovenia, for example, notes that a new breed or line of farm animals can be recognized by the minister competent for animal husbandry on the basis of advice from the country's Animal Husbandry Council. Detailed rules on the criteria and procedures for the recognition of breeds (along with specific rules for the recognition of breeds as "indigenous" or "traditional") are set out in the Regulation on Conservation of Farm Animal Genetic Resources (2011).[112] Bulgaria, in its survey response, notes that the country's Law on the Protection of New Plant Varieties and Animal Breeds of 1998 (as amended in 2010)[113] includes a list of autochthonous breeds and breeds developed in Bulgaria that are considered the property of the state, as well as provisions related to the recognition of other breeds (whether newly developed or brought in from outside the country) by the State Breed Commission. In this particular case, the law creates the basis for a *sui generis* intellectual property

DRAFT - NOT FOR CITATION

[110] Décret nº 2012/382 du 14 septembre 2012 portant organisation du Ministère de l'Elevage, des Pêches et des Industries Animales (available in French at http://faolex.fao.org/docs/pdf/cmr126963.pdf).
[111] Available at http://www.comlaw.gov.au/Details/C2011C00003/Download
[112] Pravilnik o ohranjanju biotske raznovrstnosti v živinoreji (Regulation on Conservation of Farm Animal Genetic Resources) (available in Slovenian at http://www.uradni-list.si/1/objava.jsp?urlid=200490&stevilka=4111,13.8.2004 and in English http://www.genska-banka.si/fileadmin/uploads/Strokovni_svet/Regulation_on_conservation_AnGR__Slovenia.pdf)
[113] Закон за закрила на новите сортове растения и породи животни (available in Bulgarian at http://www.wipo.int/edocs/lexdocs/laws/bg/bg/bg042bg.pdf; the original act from 1998 is available in English at http://www.upov.int/export/sites/upov/en/publications/npvlaws/bulgaria/bulgaria.pdf).

rights (IPR) system for livestock breeds: a breeder who has "created or discovered and developed" a breed can be issued with an "animal breed certificate" valid for 30 years. Another example is provided in the response from Latvia, which notes that its Agricultural Data Centre established a commission for approval of breeds in accordance with Cabinet Regulation No.475 (21.06.2011) Approval and Registration of Farm Animal Breeds.[114] The commission includes representatives from the country's Agricultural Data Centre and from scientific and educational institutions. The approval process takes into account the "number of female and male animals, characteristic traits, productivity and genetic structure of [the] population." Some countries, in contrast, have adopted a more flexible approach based on ongoing advice to government from officially recognized expert bodies. For example, the United Kingdom's National Action Plan on Farm Animal Genetic Resources (2006) recommended that this role be given to the country's National Standing Committee on Farm Animal Genetic Resources.[115] This body later developed a set of definitions[116] for use in the country's breed inventory and guidance on the evidence needed to prove that a breed should be included in the inventory.[117]

Some countries reported that legal frameworks for breed recognition are still in the process of being developed. Montenegro's survey response, for example, notes that the country's Law on Livestock Farming (2010)[118] lays down rules for the recognition of new breeds and lines of domestic animals developed in Montenegro "in accordance with the scientific methods", but also notes that secondary legislation laying down more detailed conditions and procedures needs to be developed. It further notes that developing a regulation for the recognition of already-known autochthonous breeds is an important objective with respect to the genetic assessment and conservation of these breeds.

Non-European countries that report legal instruments in this field include Brazil, where the recognition of a breed goes hand in hand with the recognition of a breeders' association (see Box 3E7) and Viet Nam. In the latter country, the Ordinance on Livestock Breeds (2004)[119] sets out rules under which "new livestock breeds shall be recognized and put on the lists of livestock breeds permitted for production and business promulgated by [the relevant ministry]." The procedure involves determining "the difference, stability, uniformity of yield, quality [and] disease resistance of new breeds", as well as any potential "harmful effects." The registration process in Indonesia is described in Box 3E8.

The survey responses provide relatively little information on the effects that legislation (or lack of legislation) in this field has on AnGR management. Neither to do they provide much information on countries' future needs in terms of developing legislation or policies in this field. Some responses note positive effects. Cyprus, for example, comments that legislation has "major implications for PDO [protected designation of origin] applications for specific products." The cases of Brazil and Indonesia described in Boxes 3E7 and 3E8 provide further examples of how sustainable AnGR management has benefited from the process of breed recognition.

Some countries note that a lack of legislation creates problems or report that the introduction of legislation is a future priority. For example, the response from Bhutan mentions that its lack of legislation hampers the conservation and sustainable use of its traditional breeds. Likewise, Nepal's response notes that official recognition of breeds would help in promoting conservation and sustainable use activities. Other responses, however, note that the absence of legislation has little effect. For example, the United States of America (as noted above, a country that relies largely on the private sector to manage its AnGR) reports that it has no legislation or policies in this field, but that this has "no negative impact on animal genetic resources management." Mauritius (a country with a

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[114] Lauksaimniecības dzīvnieku šķirnes apstiprināšanas un reģistrācijas kārtība (available in Latvian at http://likumi.lv/doc.php?id=232283).
[115] Currently the Farm Animal Genetic Resources Committee (web site: http://www.defra.gov.uk/fangr/).
[116] *Definition of a breed for the purpose of the UK National Inventory* (available at http://www.defra.gov.uk/fangr/2011/03/17/national-inventory/).
[117] *Eligibility of a UK breed for inclusion in the UK National Breed Inventory* (available at http://www.defra.gov.uk/fangr/files/Eligibility-of-a-UK-breed-for-inclusion-in-the-UK-National-Breed-Inventory.doc).
[118] Закон о сточарству (available in Montenegrin at http://www.uip.gov.me/ResourceManager/FileDownload.aspx?rid=123075&rType=2&file=Zakon_o_stocarstvu.pdf).
[119] Ordinance on Livestock Breeds (No. 16/2004/PL-UBTVQH11) (available in English at http://www.business.gov.vn/assets/33a65b539f704858a384bd5825f495f8.pdf).

small number of breeds and that, to date, has given little emphasis[120] to *in situ* conservation or policies promoting sustainable use of locally adapted breeds) notes that, although it has no legislation in place, all stakeholders accept the breed inventory used by the government in, for example, its National Biodiversity Strategic and Action Plan.[121]

Box 3E6. Official recognition of livestock breeds in Brazil

In Brazil, official recognition of livestock breeds is regulated by Law No. 4.716/1965, Decree No. 58.984/1966 and Technical Guidance SNAP 47/1987. The procedure requires the respective breeders' association (at this point in the process regarded as a "promotional association") to submit an application to the Ministry of Agriculture. The application is then assessed by Ministry technicians and experts recruited on an ad hoc basis, taking into consideration, *inter alia*, the uniqueness of the animals, the proposed descriptors and whether or not the breed has already been registered under another name. If the conclusion is that the candidate population qualifies as a separate breed, the Ministry of Agriculture will recognize it and will allow the association to start issuing registration documents for the animals, including pedigrees, and so on. Copies of these documents have to be sent to the Ministry of Agriculture so that they can be checked.

Every time a new breed is recognized, there is an increase in the number of herds and breeders, and consequently in the number of animals. Recently, two locally adapted cattle breeds have been recognized by the Ministry of Agriculture: the Curraleiro Pe-Duro and the Criollo Lageano. In the case of the Criollo Lageano, there were only two herds remaining before the recognition of the breed in 2008. Since then, the number of herds has increased to 27. There are still many locally adapted breeds that have not been recognized by the Ministry of Agriculture. One of them, the Pantaneiro cattle breed, has just (late 2013) started the process, with the creation of a promotional breeders' association.

Source: Adapted from Brazil's response to the 2013 legal survey.

Box 3E7. Registration of livestock breeds in Indonesia

Indonesia is home to many diverse plant, animal and microbial genetic resources. Not all have been managed properly or characterized to identify their valuable traits. There is great potential to enhance the use of the country's animal genetic resources in the production of meat, milk and eggs as sources of protein for human consumption. To protect these valuable resources, the Government of Indonesia, through the Minister of Agriculture, released Decree No. 19/Permentan/OT.140/2/2008 on the registration of livestock breeds. To operationalize the decree, a commission has been set up to evaluate proposals for breed registration submitted by the local governments in the breeds' home areas. The commission consists of around 20 people, including scientists from national research institutes and universities, as well as officials from the General Livestock Services. Each proposal consists of: 1) a justification for the proposed registration; 2) a description of the breed's specific traits; 3) a description of the breed's geographical distribution; and 4) information on the superiority of the breed's traits.

The operationalization of the commission was initiated in 2010 through several meetings. As of March 2013, the commission had registered the following 27 breeds: Aceh cattle (Aceh); Alabio duck (South Kalimantan); Bali cattle (Bali); Batur sheep (Central Java); Gaga chicken (South Sulawesi); Garut sheep (West Java); Gembrong goat (Bali); Kaligesing goat (Central Java); Kisar sheep (Maluku); Kokok-balenggek chicken (West Sumatera); Lakor buffalo (Maluku); Madura cattle (East Java); Magelang duck (Central Java); Moa buffalo (Maluku); Palu sheep (Central Sulawesi); Pampangan buffalo (South Sumatera); Pegagan duck (South Sumatera); Pelung chicken (West Java); Pesisir cattle (West Sumatera); Pitalah duck (West Sumatera); Rambon goat (Central Java); Sentul

[120] As reported in the country report from Mauritius.
[121] Available in English at https://www.cbd.int/doc/world/mu/mu-nbsap-01-en.pdf

chicken (West Java); Sumbawa buffalo (West Nusa Tenggara); Sumbawa cattle (West Nusa Tenggara); Sumbawa horse (West Nusa Tenggara); Tegal duck (Central Java); and Wonosobo sheep (Central Java). Each registration is established via a ministerial decree.
After the release of a ministerial decree for the registration of a breed, the local government releases local regulations related to the management of the breed. The rules specify that the local government should take care of the breed by:
1. allocating budget for maintaining the breed;
2. maintaining the breed's diversity; 3) improving income generation from the breed; and
3. involving many farmers in conservation activities.

Provided by Bess Tiesnamurti.

Genetic improvement programmes

As discussed in Part 3 Section [crossref] and Part 4 Section [crossref], genetic improvement programmes are complex undertakings that involve a number of different elements. They can have major implications for the livelihoods of individual livestock keepers and breeders, for the profits of commercial organizations and for national objectives such as food security and the maintenance of diverse portfolios of AnGR. However, in many countries, establishing and sustaining breeding programmes has proven to be a challenge (FAO, 2007; see also Section [crossref]). The roles of different stakeholder groups, including those of public-sector bodies, in the organization and implementation of genetic improvement programmes (or the extent to which their participation in future programmes is regarded as an objective) varies greatly from country to county (see Part 3 Section [crossref] for further discussion). Along with major differences in the state of technical and organizational capacity to implement the various elements of breeding programmes, this means that the challenges involved in establishing an appropriate legal and policy framework for genetic improvement programmes are very diverse.

Policies supporting or influencing the objectives of breeding programmes – or promoting changes in breed utilization (e.g. substitution of one breed by another) – are discussed in Section [crossref], based on the material provided in the country reports. The emphasis below in this subsection is therefore on legal frameworks. Where relevant, policies addressing the provision of specific services or the development of specific organizational structures that contribute to the implementation of breeding programmes are noted.

Eighty-two percent of the OECD countries that responded to the legal survey indicated that they have legislation addressing animal breeding and genetic improvement in place (Figure 3E1). Slightly fewer (76 percent) indicated that they have policies in place. Among non-OECD respondents, the equivalent figures were 45 and 52 percent, respectively, with a further 14 percent reporting that they have legislation in preparation and 28 percent that they have policies in preparation.

Box 3E8. The legal and policy framework for breeding programmes in Bhutan

The legal and policy framework for animal breeding in Bhutan is based on the Livestock Act of Bhutan (2001)[122] and the Livestock Breeding Policy of 2007. According to Chapter III of the Livestock Act, which addresses "designated farms", the Ministry of Agriculture may establish its own farms for genetic improvement and conservation and may also "help private farms in breeding." The Act also includes rules related to the supply of breeding animals to farms and the use of artificial insemination and embryo transfer. The Breeding Policy sets out strategies for the development of breeding programmes and practices for large ruminants and – in less detail – for the country's other main livestock species. In the case of cattle, separate strategies are in place for peri-urban areas (based on cross-breeding) and for remote rural areas (based on promotion of the locally adapted Siri cattle

[122] Available in English at http://www.nationalcouncil.bt/wp-content/uploads/2011/02/Livestock_En_01.pdf

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and Mithun crosses, and eventual establishment of community-based breeding programmes). All the species- or breed-level strategies are based on a situational analysis of the current state of breeding practices and knowledge. Despite the systematic approach, the country's response to the 2013 legal survey reports that breeding policies for species other than cattle remain in an "undeveloped state" and that this has contributed to an increase in the use of exotic breeds and cross-breeds and a decline in the populations of locally adapted breeds. In the case of cattle, Bhutan's country report states that the existing policy will favour the effective management of locally adapted multipurpose cattle, but that little has yet been done in terms of the implementation of measures to improve their performance.

One factor that facilitates the establishment of breeding programmes is the existence of a national animal identification system. Because of the multiple benefits that can be obtained from having such a scheme, compulsory animal identification systems are widespread in developed countries. Eighty-eight percent of OECD countries that responded to the legal survey reported that they have legislation in place in the field of "animal identification and recording" (Figure 3E1). The figure rises to 100 percent if countries reporting animal identification laws related to animal health (see below) are included. There is also growing interest in the establishment of such schemes in developing countries. Sixty-nine percent of non-OECD survey respondents indicated that they have legislation related to animal identification in place and a further 7 percent indicate that they are developing legislation. The main motivation for the development of animal identification systems is to improve animal health and the traceability of animal products (see below for further discussion). However, once systems exist they can also serve other purposes, such as the identification of animals for breeding purposes.

In many countries, particularly in the developed regions of the world, the main stakeholders involved in implementing breeding programmes are breeders' associations. These associations are usually non-governmental bodies operated by their members. National authorities may, however, choose to introduce legal and policy measures to promote the establishment of such organizations or to regulate their operation, with the aim of promoting the sustainable development of national AnGR and improving rural livelihoods, food security and so on. Defined standards and procedures for the various elements of breeding programmes can also help ensure effective implementation and create conditions in which breeding animals can be traded with confidence.

As discussed above in the subsection on regional frameworks, EU member countries are obliged to comply with EU-level directives and decisions related to animal identification, the recognition of breeders' associations, the keeping of herdbooks, the contents of pedigree certificates, performance testing and genetic evaluation and the acceptance of animals for breeding. Countries vary in the extent to which they go beyond establishing the basic EU-prescribed legal framework and seek more actively to influence the objectives and implementation of breeding programmes. For example, the survey response from the Netherlands states that genetic improvement is completely in the hands of the private sector and that the only remaining involvement of the government in breeding is through pre-competitive public–private research programmes and other specific research projects. Germany mentions that its Animal Breeding Act (see above) regulates the process of recognizing breeding programmes and makes performance recording and the estimation of breeding values mandatory, but contains no rules directly addressing breeding goals. It notes that in the case of breeds that are at risk of extinction, conservation breeding programmes that do not involve performance evaluation are permitted. It further notes that, if necessary, breeders' associations can be required to cooperate in the implementation of conservation measures (although this is reported not to have happened to date). Slovenia, in its country report, mentions that in order (*inter alia*) to ensure the maintenance of genetic diversity and the overall progress of livestock sector, it has established a "basic common breeding programme" for all livestock species, the implementation of which – by breeding organizations in collaboration with research institutions – is financed by the government. Rules related to the establishment and implementation of the common programme are set out in the country's Livestock Breeding Act.[123] The implementation of this programme, and of other approved breeding

[123] Zakon o Živinoreji (ZŽiv) (available in Slovenian at http://www.uradni-list.si/1/objava.jsp?urlid=200218&stevilka=716,12.2.2002 and in English at http://www.genska-

DRAFT - NOT FOR CITATION

programmes, forms the basis of the country's conservation programme – in accordance with the requirements of its Regulation on Conservation of Farm Animal Genetic Resources. Further information on legislation related to conservation breeding programmes is provided in the following subsection on conservation.

Among countries elsewhere in the world, instruments addressing the establishment or operation of breeders' associations are also the most commonly reported type of legislation related to breeding programmes. Fifty-two percent of non-OECD respondents indicated that they have legislation of this type in place. Costa Rica's response, for example, mentions its Executive Decree No. 19400 (1989),[124] which transfers responsibility for the management of genealogical registers to breeders' associations and prescribes minimum standards for the operation of these associations. Zimbabwe's response mentions the Zimbabwe Herd Book, a registering body for breeders' associations that was established by act of parliament in 1981.[125] Namibia mentions its Livestock Improvement Act (1977), which – as well as containing provisions related to the recognition of breeders' associations – grants exclusive rights to the Namibian Stud Book Association to issue pedigree certificates. Responses from several countries (e.g. Ghana, Sri Lanka, Suriname and the United Republic of Tanzania) indicate that they are in the process of developing legislation in this field.

Few of the survey responses provide any information on legal instruments related to the establishment of breeding programmes by the public sector. Viet Nam's Ordinance on Livestock Breeds (2004)[126] sets out basic objectives for state policies on livestock breeding, which include ensuring "the development of livestock breeds along the direction of industrialization and modernization on the basis of livestock breed development strategy, planning and plans", supporting "organizations and individuals tasked to multiply or raise purebred livestock breeds, prototypal, grandparental and nucleus breed stocks" and encouraging "organizations and individuals to produce and use new livestock breeds." The above-mentioned Namibian Livestock Improvement Act allows for the establishment "by the Minister"[127] of schemes to evaluate and certificate the performance of particular kinds and breeds of animals with the object of improving their genetic production potential. The Livestock Act of Bhutan (2001)[128] is described in Box 3E9.

Several of the AnGR-related laws found in FAOLEX and listed above in the subsection on "general instruments" include provisions related to the role of the state in coordinating and/or implementing genetic improvement programmes – and in some cases the operation of state-run breeding establishments or the provision of breeding services by the public sector. Madagascar's Decree N°2010-106, [129] for example, establishes the country's National Council for Genetic Improvement, which is allocated the task (*inter alia*) of developing national genetic improvement programmes. The "genetic improvement service" of the Livestock Ministry is charged with coordinating and monitoring the implementation of the council's recommendations. In addition, regional "Breed Offices" are given the task of supporting and overseeing the operation of herd books by livestock-keepers' associations. As another example, Kyrgyzstan's Law on Pedigree Livestock Breeding[130] includes provisions related to the organization of a state herd book and to the supply of state support to breeding organizations. It

banka.si/fileadmin/uploads/Strokovni_svet/Livestock_Breeding_Act.pdf). In the English version, the programme is referred to as the "Joint basic breed programme".

[124] Traspasa Registro Genealógico de Ganado a Asociación de Productores y Criadores de Ganado N° 19400-MAG (available in Spanish at http://www.pgr.go.cr/scij/scripts/TextoCompleto.dll?Texto&nNorma=4133&nVersion=4378&nTamanoLetra=10&strWebNormativa=http://www.pgr.go.cr/scij/&strODBC=DSN=SCIJ_NRM;UID=sa;PWD=scij;DATABASE=SCIJ_NRM;&strServidor=\\pgr04&strUnidad=D:&strJavaScript=NO

[125] Registration of Pedigree Farm Livestock Act, Act 21/1981 (available at http://faolex.fao.org/docs/pdf/zim60476.pdf).

[126] *Công Báo* No. 16, 24 April 2004, pp. 20–30 (available in English at http://faolex.fao.org/docs/pdf/vie45179.pdf).

[127] The Minister of Agriculture, Water and Rural Development.

[128] Available in English at http://www.nationalcouncil.bt/wp-content/uploads/2011/02/Livestock_En_01.pdf

[129] Décret N°2010-106 du 2010/03/02 réglementant l'amélioration génétique des animaux domestiques et domestiqués à Madagascar (available in French at http://faolex.fao.org/docs/pdf/mad131582.pdf).

[130] Закон Кыргызской Республики о племенном деле в животноводстве Кыргызской Республики (available in Russian with an English abstract at http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=132067&database=faolex&search_type=link&table=result&lang=eng&format_name=@ERALL).

DRAFT - NOT FOR CITATION

assigns a role in coordinating the activities of breeding organizations to an "Authorized State Body for Pedigree Stockbreeding" and also includes provisions related to the operation of state breeding farms.

In so far as they provide any information on the effects that legislation related to breeding programmes is having on AnGR management, the survey responses generally indicate that the reported instruments are having a positive effect. France, for example (referring to both legal and policy measures), states that "the collective organization of the measures allows different organizations to carry out their missions ... [in] animal breeding, management of genetic diversity and the sustainable conservation of genetic resources." Likewise, the response from Austria states that "the regulations guarantee that a breeders' organisation is competent and works according to approved good practice methods." The responses from countries where there is no legislation in place generally provided little detailed information on their future priorities. The country report from Rwanda, however, notes that the main weakness of the national legal framework is the lack of an "animal breeding law" that would (*inter alia*)[131] regulate " who is entitled to collect and sell semen and from what animals, who can do inseminations and [under]what ... minimum standards/requirements, pedigree registration[,] ... the recognition of breed associations and their herd books, the right to issue pedigree certificates and ... [the implementation of] performance testing and genetic evaluation".

Few countries report specific gaps in their existing provisions (although some note that implementation needs to be strengthened) or any problems caused by existing instruments. One exception is provided in the United Kingdom's country report, which lists "zootechnical legislation requirements being unachievable for numerically small breeds" among the obstacles to enhancing AnGR conservation measures. As is the case in several other areas of AnGR management, the survey response from the United States of America notes that the absence of legislation on breeding programmes (other than on animal identification) does not cause any problems with regard to AnGR management.

Reproductive biotechnologies

Legal and policy frameworks related to the use of reproductive technologies such as artificial insemination and embryo transfer have the potential to affect both breeding and conservation programmes. More broadly, they may influence the types of AnGR used by livestock keepers (e.g. if programmes only provide genetic material from certain breeds) and hence potentially affect both livestock-keeping livelihoods and the diversity of national livestock populations. The extent to which these technologies are in use in livestock production at country level is discussed in Part 3Section [crossref]. Relevant policies in this field can include instruments that aim to promote the use of such technologies via the provision of subsidized services or via extension activities. In the case of legal instruments targeting the use of reproductive technologies, the main objectives are generally to ensure the quality of the materials used in zoosanitary and genetic terms. Provisions typically relate to the licensing and inspection of artificial insemination centres and other facilities, quality controls on donor animals, and inspection and certification of imported or exported materials. Bhutan's Livestock Act of 2001 can serve as an example: this law contains a subchapter on artificial insemination and embryo transfer, which provides for the establishment of artificial insemination units (laboratories and housing facilities for donor animals) according to prescribed standards, forbids the use of semen from unlicensed premises, requires that donors of semen or embryos be certificated for genetic merit and disease status, requires that consignments of semen and embryos entering the country have a valid import licence and provides for inspection of artificial insemination units and laboratories used for semen processing and embryo storage. Further provisions are included in the country's Livestock Rules and Regulations of 2008 and the Livestock Breeding Policy of 2007. A further example (from Brazil) is provided in Box 3E9.

A large majority (88 percent) of OECD countries reported in their survey responses that they have legislation in place related to the use of reproductive biotechnologies (Figure 3E1). The figure for

[131] The other objective mentioned is to regulate the entry of new genetic material into the country.

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policies was lower (47 percent). This may be because developed countries where the service provision is largely in the hands of the private sector do not feel the need for policies in this field. In the case of non-OECD countries, the figures were 55 percent for legislation and 31 percent for policies.

Survey responses from countries that have legislation in place generally indicate that it serves its purpose of promoting the safe and efficient use of reproductive biotechnologies. A problem is, however, noted in the country report from Cyprus, which states that legal constraints affecting the use of fresh semen create difficulties for the use of artificial insemination in locally adapted ruminant breeds. The survey responses also mention few specific gaps in existing legislation. The response from Burundi notes the need to expand the species coverage of its legislation, while the responses from both Austria and Spain note the potential need to develop legislation to regulate the use of cloning. The only response that mentions any provisions specifically addressing potential problems that legal restrictions on the use of reproductive technologies might cause in AnGR management comes from Spain, whose response states that in the case of Royal Decree 841/2011[132] exceptions to the requirements of the law are possible in the case of breeds that are at risk of extinction or difficult to manage or for the establishment of a gene bank. It further states that future requirements include a system for determining with more precision the situations in which exemptions from zoosanitary rules should be allowed. With regard to problems caused by the absence of legislation, Malawi's country report notes that the "lack of a breeding protocol and regulation has led to use of non-evaluated bulls for AI [(artificial insemination)] and potential inbreeding due to few bulls being used."

Box 3E9. The legal framework for the use of reproductive biotechnologies in Brazil

Companies that produce, collect, process or market the semen and embryos of cattle, buffaloes, goats, sheep, horses, pigs or poultry in Brazil must be registered with the Ministry of Agriculture. These companies are responsible for sending information about the animals from which material is collected, as well as the number of semen samples or embryos collected, to the Inspection Division of Animal Genetic Material. The regulatory basis for the use of animal genetic material in Brazil is Law No. 6.446/1977 [133]which provides for the mandatory inspection and surveillance of semen used for AI. This law is regulated by Decree No. 187/1991,[134] which defines the role of the Ministry of Agriculture in the registration of sires as well as in the registration of industrial and commercial companies and in the surveillance of genetic material imported or exported via airports, ports and border stations.
Any owner sending an animal as a donor to an AI centre must present performance certification indicating that the genetic material from that animal will be able to improve the production records of the respective breed.

Source: Adapted from Brazil's response to the 2013 legal survey.

Conservation

Because the state of conservation programmes and policies is discussed in Part 3 Section [crossref], the focus in this subsection is on legal instruments. Legislation on conservation may include a range of provisions, including those targeting the establishment of institutional responsibilities for implementing or coordinating national conservation programmes, the definition of the responsibilities

[132] Real Decreto 841/2011, de 17 de junio, por el que se establecen las condiciones básicas de recogida, almacenamiento, distribución y comercialización de material genético de las especies bovina, ovina, caprina y porcina, y de los équidos (available in Spanish at http://www.boe.es/boe/dias/2011/07/14/pdfs/BOE-A-2011-12107.pdf)..
[133] Lei nº 6.446, de 5 de Outubro de 1977. Dispõe sobre a inspeção e a fiscalização obrigatórias do sêmen destinado à inseminação artificial em animais domésticos, e dá outras providências (available in Portuguese at http://www2.camara.leg.br/legin/fed/lei/1970-1979/lei-6446-5-outubro-1977-366369-publicacaooriginal-1-pl.html).
[134] Decreto No. 187 de 9 de AGOSTO de 1991. Regulamenta a Lei n° 6.446, de 5 de outubro de 1977, que dispõe sobre a inspeção e fiscalização obrigatórias do sêmem destinado à inseminação artificial em animais domésticos (available in Portuguese at https://www.planalto.gov.br/ccivil_03/decreto/1990-1994/D0187.htm).

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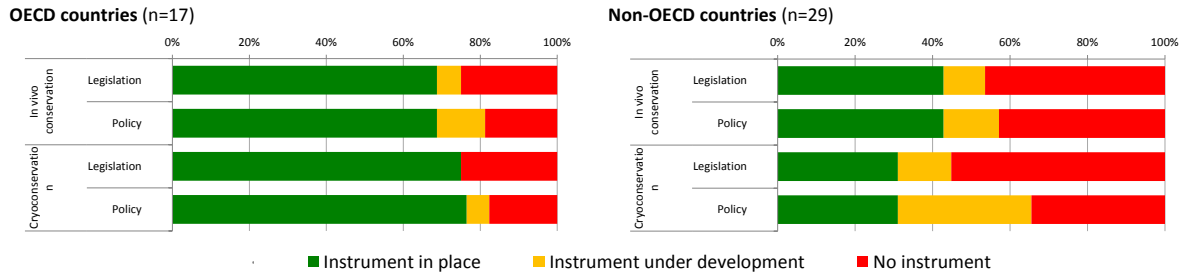
of these institutions, the establishment of specific conservation facilities such as gene banks, the establishment of the legal basis for the provision of support payments to the keepers of at-risk breeds, and the definition of the responsibilities of particular stakeholder groups such as breeders' associations.

Among respondents to the legal survey, 71 percent of OECD countries reported that they have legislation targeting AnGR conservation and 88 percent that they have policies (Figure 3E2). The figures for non-OECD countries were 48 percent for legislation and 44 percent for policies. Countries were also asked specifically about measures targeting *in vivo* conservation and cryoconservation (Figure 3E2).[135] In the case of OECD countries, in both the legal and the policy categories, more respondents reported that their instruments target cryoconservation than *in vivo* conservation (71 percent vs. 65 percent for legislation and 76 percent vs. 65 percent for polices). In contrast, in the case of non-OECD countries, more respondents reported instruments targeting *in vivo* conservation than cryoconservation (41 percent vs. 31 percent for both legislation and policies). However, growing interest in cryoconservation among non-OECD countries seems to be indicated by the substantial proportion (34 percent) that reported that they have a policy instrument under development in this category.

Figure 3E2. Types of conservation targeted by legal and policy instruments



As noted above in the subsection on instruments targeting the general management of AnGR, a number of countries have legal instruments in place that assign responsibility for implementing conservation programmes to specific bodies as part of their overall mandates to implement or support national AnGR management programmes. A few other countries report legislation related specifically to the establishment of gene banks. One example is the Kenya Animal Genetic Resources Centre Order (2011),[136] which, *inter alia*, establishes the centre as a state corporation, defines its functions and the composition and competencies of its governing board, and establishes arrangements related to its funding. [137] At a more fundamental level, legislation may serve to establish the promotion of AnGR conservation as one of the responsibilities of the national government. For example, France's Agricultural Orientation Law (2006),[138] states that the government is authorized to take (by ordinance) the measures necessary to conserve the diversity of AnGR, making specific efforts to conserve local breeds, particularly those from mountain areas. The same country's Rural and Sea

[135] Answering these subquestions was optional. Countries that reported instruments targeting conservation were asked to indicate whether these include measures specifically related to the two categories of conservation. In fact, almost all countries provided answers to both the subquestions regardless of whether or not they had answered the main question. The few gaps that remained could be filled based on the assumption that if no conservation instruments were reported there could be no provisions targeting the individual categories of conservation. It was thus possible to calculate figures base on the full dataset of 46 countries.

[136] Available in English at http://faolex.fao.org/docs/pdf/ken106282.pdf (the order is mentioned in Kenya's country report in connection with the country's plans to establish an *in vitro* gene bank).

[137] The above-mentioned legislation establishing the National Animal Germplasm Program in the United States of America is another example.

[138] **Loi n° 2006-11 du 5 janvier 2006 d'orientation agricole (available in French at** http://www.legifrance.com/affichTexte.do;jsessionid=EFEF5063849D6F7266DD2AC01A12843F.tpdjo07v_2?idSectionTA=LEGISCTA000006098433&cidTexte=JORFTEXT000000264992&dateTexte=20060107**).**

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Fishing Code[139] states that the state shall ensure the conservation of AnGR diversity in collaboration with all relevant stakeholders. As another example, Viet Nam's Ordinance on Livestock Breeds (2004)[140] states that the state "shall invest in and render support for the collection and conservation of precious and rare livestock gene sources; build establishments for keeping precious and rare livestock gene sources; and preserve precious and rare livestock gene sources in localities."

The extent to which the activities of bodies mandated to manage national conservation programmes are prescribed in legal instruments varies greatly from country to country. Slovenia's above-mentioned Regulation on Conservation of Farm Animal Genetic Resources, for example, includes quite detailed provisions related both to the elements of the national conservation programme and to associated activities such as the official recognition of breeds (see above). The conservation programmes prescribed in this regulation are based on breeding programmes certified in accordance with the legislation described above in the subsection on genetic improvement, but also include risk-status monitoring and conservation-related research, education, training and public-awareness raising, as well as proposals for *ex situ in vivo* conservation measures and for activities related to the ethnological, cultural, historical and environmental roles of the respective breeds.

As noted above, in a number of countries, legislation addressing the operation of breeding programmes includes explicit references to conservation or the need to maintain genetic diversity. Spain's Royal Decree 2129/2008, for example, classifies "[breed] improvement programmes" either as "selection programmes" or as "conservation programmes." A conservation programme is defined as an "improvement programme which has as its objective the maintenance of genetic diversity to guarantee the conservation of a breed, encaste, bloodline or variety and to prevent its extinction or to increase its population." Improvement programmes of whatever category have to be submitted to the competent authority as part of the process through which the respective breeders' association acquires official recognition. The obligations of breeders' associations under the decree include implementing the officially approved improvement programme (whether "conservation" or "selection") for their respective breed. If a conservation programme has been approved, participation "in the form that the competent authorities stipulate" is obligatory for all livestock breeders who belong to the respective breeders' association. The contents of a conservation programme (i.e. the elements that have to be included in the plans submitted for approval by the competent authority) are listed in an annex to the decree. The decree further states that the decision as to whether or not a conservation programme is required is to be based on the "degree of development, population size, zootechnical value and productive capacity" of the breed.

As noted above in the subsection on regional frameworks, EU legislation includes provisions related to support payments for the keepers of breeds considered to be at risk of extinction. Several survey responses from EU member countries mention conservation programmes that include payments made in accordance with this legislation. Examples include the Austrian Agri-Environmental Programme 2007–2013,[141] which allowed for payments to be made to the keepers of 31 "acknowledged endangered breeds" provided that they were members of the respective breeding organization, followed the breeding programme for the breed and – if the breed was classified as "highly endangered" – followed the mating recommendations drawn up by the breeding organization.

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[139] Code rural et de la pêche maritime. Article D653-9 Créé par Décret n°2006-1662 du 21 décembre 2006 - art. 3 JORF 23 décembre 2006 (available in French at http://www.legifrance.gouv.fr/affichCode.do;jsessionid=B484D5F8180F75301D60390B72E5B2E5.tpdjo13v_2?idSectionTA=LEGISCTA000006168555&cidTexte=LEGITEXT000006071367&dateTexte=20140319).

[140] Available at http://www.business.gov.vn/assets/33a65b539f704858a384bd5825f495f8.pdf

[141] For details of AnGR conservation measures implemented under this scheme, see Austrian Programme for the Conservation of Acknowledged Endangered Breeds (available in English at http://www.oengene.at/images/stories/neu/downloads/oengene%2016s_engl_low%20res.pdf).

Box 3E10. The legal basis for animal genetic resources conservation in Poland

Poland's Animal Breeding Law of 20 August 1997,[142] brought in after the introduction of the market economy into the country, set out provisions for fundamental changes in the organization of breeding and reproduction in farm animals. The law enabled the transfer of responsibilities over animal breeding from the state (the Central Animal Breeding Office) to breeders' organizations and created the legal and institutional conditions for this change.

The 1997 law did not contain any provisions specifically targeting the conservation of animal genetic resources; the only reference appeared in Article 1, which indicated that the scope of the law encompassed the regulation of issues related to animal breeding and the management of animal genetic resources.

The designation of Poland's National Focal Point for Animal Genetic Resources and, particularly, the process of preparing the country report for the first report on *The State of the World's Animal Genetic Resources*, contributed to awareness raising and to an informed discussion on the further development of animal breeding legislation. The National Focal Point played an active role in this development and lobbied for the inclusion of an acknowledgment of the state's obligation to conserve AnGR in the legislation.

Amendments introduced to the 1997 law in 2004 included, for the first time, an article setting out provisions for the conservation of breeds, varieties and lines of farm animals threatened with extinction due to small or decreasing population size (Article 21a). This was a major development that was fundamental to the establishment of a legal and institutional framework for AnGR conservation. The article also included provision for an implementing act, via which the Minister of Agriculture would identify an entity to be given responsibility for implementing and coordinating conservation programmes and for the collection and storage of biological material for cryoconservation. While efforts to conserve native breeds had been underway in Poland since the 1980s, the amended law established a legal basis for comprehensive conservation activities and resulted in the coordination of these activities being entrusted to the National Research Institute of Animal Production.

In 2007, the further development and transformation of the organization of animal breeding and reproduction in Poland, including implementation of European Union legislation, led to the adoption of a new Animal Breeding Law.[143] Provisions for conservation of endangered breeds were further enhanced (Article 28). The law sets out the elements of conservation programmes and defines the responsibilities of the entity entrusted by the Minister of Agriculture with coordination of animal genetic resources conservation activities. The law coheres with the Rural Development Programme (2014–2020, earlier phases 2004–2006 and 2007–2013), which provides support to farmers who keep endangered local breeds.

Issues for consideration in the further development of the legal framework for conservation include the formal recognition of the National Bank of Animal Genetic Resources Biological Material and amendments to the species list that are eligible for inclusion in conservation programmes.

Provided by Elżbieta Martyniuk, National Coordinator for the Management of Animal Genetic Resources, Poland.

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The survey responses generally did not provide detailed information on how exactly the reported legal and policy instruments contribute to the implementation of concrete conservation activities. In some cases, countries reported that conservation activities underpinned by legislation have been associated with improvements in the status of at-risk breeds. Taking Austria again as an example, the country's survey response notes that since its Agri-Environmental Programme was established in 1995,[144] the populations of all at-risk breeds in the country have grown significantly and none have been lost. It should, however, be borne in mind that, while the success of a national conservation programme may be influenced by legal frameworks, it is likely also to depend on a wide range of other factors

[142] Dz.U. 1997 Nr 123 poz. 774 Ustawa z dnia 20 sierpnia 1997 r. o organizacji hodowli i rozrodzie zwierząt gospodarskich (available in Polish at http://isap.sejm.gov.pl/DetailsServlet?id=WDU19971230774).

[143] Dz.U.07.133.921 Ustawa z dnia 29 czerwca 2007 r. o organizacji hodowli i rozrodzie zwierzàt gospodarskich (available in Polish at http://faolex.fao.org/docs/pdf/pol87292.pdf).

[144] The predecessor of the programme mentioned in the preceding paragraph.

including the availability of resources, capacity to plan and implement appropriate activities and "political will" to support them on the part of the national authorities and other stakeholders. The relative significance of legal and other factors – and chains of cause and effect among them – are difficult to identify and are likely to vary from country to country. In some cases, the existence of legislation may help promote the provision of financial resources: some legal instruments (e.g. China's Stock-breeding Law of 2005 [145] and Montenegro's Law on Livestock Farming – 2010)[146] make specific references to the inclusion of AnGR-related funding in state budgets. Alternatively, a lack of funding may inhibit the establishment of legislation. For example, the survey response from Latvia notes that developing laws and regulations that allocate institutional responsibilities for implementing conservation programmes is an important objective, but that this has not been done because regular funding to support the work has not been secured.

The survey responses generally do not report any specific problems associated with current legal or policy frameworks or any specific gaps or weaknesses in them. Some countries did, however, report problems associated with the absence of legislation. The response from Bhutan, for example, states that the "lack of legislation on conservation programs hampers execution of conservation, especially in-situ conservation. The Biodiversity Act of Bhutan 2001 needs to be updated and AnGR conservation and management [needs to be] ... included." Similarly, the country report from Italy mentions that the country's ability to make appropriate plans for AnGR conservation is constrained by the lack of a national law, although the problem is partially mitigated by the existence of several regional laws.[147]

Importation of genetic material

As discussed in Section [crossref] of Part 1, there are considerable international flows of AnGR. While it is generally accepted that enabling livestock keepers and breeders to access a wide range of genetic material, whether from inside or outside their home countries, is an important objective, countries may for various reasons wish to control the flow of genetic resources across their borders. The most common reason for placing legal restrictions on the import of genetic material is to prevent the entry of transboundary animal diseases into the country. Controls of this type, which have to comply with international regulations related to trade barriers (see above), are discussed below. Countries may also choose to put in place rules related to the characteristics of the genetic material itself. Rules of this type potentially relate to the genetic quality of specific consignments of genetic material (e.g. requiring that it comes from animals that have been subject to genetic evaluation) or to categories of genetic material (e.g. to the breed from which it comes).

The proportion of respondents to the legal survey that reported legal instruments in this category was 52 percent in the case of OECD countries and 45 percent in the case of non-OECD countries (Figure 3E1). The equivalent figures for policies were 29 percent and 31 percent, respectively. Several countries indicated that they have legislation in place that aims to ensure the quality of imported genetic material. As discussed above in the subsection on regional frameworks, imports of genetic material into EU member countries from "third countries" (i.e. non-member countries) have to comply with rules set out in the relevant EU directive.[148] A number of European countries refer to this in their survey responses. Several countries from other regions of the world also report legislation in this field. Brazil, for example, reports that imported material must be accompanied by a pedigree record of at least three generations and by performance certification attesting to the potential of the

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[145] Available in English at http://faolex.fao.org/docs/texts/chn61879.doc
[146] Закон о сточарству (available in Montenegrin at http://www.uip.gov.me/ResourceManager/FileDownload.aspx?rid=123075&rType=2&file=Zakon_o_stocarstvu.pdf).
[147] For example: Legge regionale 14 ottobre 2008, n. 26 Tutela delle risorse genetiche autoctone vegetali ed animalidi interesse agrario. B.U. Regione Basilicata N. 50 del 16 ottobre 2008 (available in Italian at http://www.old.consiglio.basilicata.it/Lavori/leggi_promulgate/leggi2008/L2008-026.asp).
[148] Council Directive 94/28/EC of 23 June 1994 laying down the principles relating to the zootechnical and genealogical conditions applicable to imports from third countries of animals, their semen, ova and embryos, and amending Directive 77/504/EEC on pure-bred breeding animals of the bovine species (available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31994L0028:EN:NOT).

material to improve the production levels of the respective breed. Likewise, the survey response from Ecuador notes that, in order to guarantee the development of the national livestock sector, the introduction of animals of low zootechnical quality for the purpose of breeding is prohibited, even in the case of international donations, and that import documents for breeding animals or other genetic material must include pedigrees.[149] Namibia's response notes that the relevant instrument in this field is the above-mentioned Livestock Improvement Act of 1977. This law requires that anyone wishing to import animals, semen, ova or eggs into Namibia must obtain written permission from the Registrar of Livestock Improvement. If a breeders' society exists for the respective breed, the application must be lodged with the society, which will then make a recommendation to the Livestock Improvement Board.

It has sometimes been proposed that countries should require compulsory assessments of potential impacts on AnGR diversity, livelihoods and the environment before allowing a new breed to be imported. Counter arguments are that such measures can constitute a barrier to trade and that ensuring that breeders and livestock keepers are sufficiently well informed to make appropriate decisions about the type of animals they wish to use (for discussion see Tvedt *et al*., 2007; Pilling 2007). None of the countries that responded to the legal survey reported measures any instruments requiring compulsory impact assessments. However, South Africa's country report notes that its Animal Improvement Policy (2006)[150] calls for "biological impact studies" before new breeds are imported to assess their potential impact on locally adapted AnGR. A few survey responses express some concern about the absence of such measures. The response from Cyprus, for example, notes that the "import of exotic genetic material that cannot cope with [the] local production environment, results in financial losses for the farmers and, sometimes, to genetic dilution of local animal genetic resources" and the need for "tighter control, policies and infrastructure to allow for genetic assessment before introduction of genetic material for the purpose of animal husbandry." Some survey responses advocate an approach based on awareness-raising rather than on legal measures. The response from the Czech Republic, for example, states that future needs include carrying out an assessment of the suitability of imported material from different breeds and publishing its results "to improve the general awareness on this issue and facilitate farmers' decisions."

Animal genetic resources-related research

A lack of sufficient information about the characteristics of AnGR, particularly of locally adapted breeds, is often noted as a constraint to their effective management (FAO, 2007), as is a lack of appropriate tools for their characterization, conservation, use and development. Relevant legislation in this field might include instruments that prescribe the inclusion of AnGR-related research in national research activities and/or establish the institutional framework for such research activities (e.g. establishing research organizations or prescribing their mandates). Research activities may also be affected by legislation in fields such as animal welfare, zoosanitary protection and ABS.

While several survey responses note that research on AnGR is neglected, a number of legal and policy instruments are reported. Most OECD respondents (76 percent) indicated that they have relevant policies in place (Figure 3E1). Fewer (53 percent) reported legislation. The equivalent figures for non-OECD countries were 48 percent for both policies and legislation. Among legal instruments, reported examples include Slovenia's Regulation on the Conservation of Farm Animal Genetic Resources (2011),[151] under which the activities to be covered by the country's Programme for Conservation of

[149] From the legal survey response: "En el año 1975 bajo el decreto Oficial No. 954 El Ministerio de Agricultura y Ganadería a través del Departamento de Mejoramiento Genético de la Dirección de Desarrollo Ganadero en El Art. 12 de la Ley de Fomento Agroproductivo y Forestal vigente."

[150] Animal Improvement Policy for South Africa. Notice 165 of 2007. *Government Gazette*, No. 30459 (16 November 2007: 41–66 (available at http://govza.gcis.gov.za/sites/www.gov.za/files/30459_1652_1.pdf).

[151] Pravilnik o ohranjanju biotske raznovrstnosti v živinoreji (Regulation on Conservation of Farm Animal Genetic Resources) (available in Slovenian at http://www.uradni-list.si/1/objava.jsp?urlid=200490&stevilka=4111,13.8.2004 and in English at http://www.genska-banka.si/fileadmin/uploads/Strokovni_svet/Regulation_on_conservation_AnGR__Slovenia.pdf)

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Farm Animal Genetic Resources include "research, education, training, and raising public awareness and promotion in the field of conservation of livestock biodiversity." Under the same instrument, the organization "appointed as a public-service gene-bank for animal husbandry" is charged with research into the zootechnical and molecular characteristics of indigenous breeds. Most of the reported legal instruments in this category do not include such detailed AnGR-specific provisions, but outcomes in terms of promoting research on the topic are generally reported to be positive. The precise mechanisms involved are not always clear. However, the response from Latvia (which reports "no specific regulations regarding to research related to AnGR") links the need for legislation to the need for constant funding for AnGR-related research.

Reported national policies that target AnGR-related research include the Renewable Natural Resources Research Policy of Bhutan (2011),[152] whose section on veterinary and livestock health includes the objective of enhancing "sustainable livestock production and health through participatory selective breeding, identification of promising indigenous animals and animal products"; Costa Rica's State Policy for the Food and Agriculture Sector and Rural Development,[153] which includes a strategy for improving the infrastructure for research into genetic improvement (focusing particularly on the creation of gene banks and the establishment of public–private partnerships for the management of genetic resources); and Malaysia's National Strategies and Action Plans on Agricultural Biodiversity Conservation and Sustainable Utilization,[154] which includes a subsection on "monitoring and research" of AnGR. The survey response from Germany notes that "research on conservation and sustainable use of AnGR is part of the research agenda of public research conducted by the Ministry of Agriculture and other institutions." It also notes that a number of research programmes not specifically focused on AnGR (e.g. on organic farming and various aspects of biodiversity management) can, in principle, include projects in this field. The response from Spain, likewise, notes that several National Research Plans implemented by the National Institute for Agricultural and Food Research and Technology (INIA)[155] have included activities related to AnGR.

Transgenic animals and the use of transgenic products

Given the number of genetically modified crop varieties available for use in agriculture and the various controversies that surround their use, many countries have put in place regulatory frameworks of one kind or another addressing the use of genetically modified organisms (GMOs) in agriculture and the use of products derived from GMOs. These frameworks generally establish mechanisms via which specific GMOs or products derived from GMOs can be assessed and (if deemed appropriate) certified for use (see Box 3E12 for an example) and/or prohibit or restrict the use of particular categories of GMOs or GMO-derived products. To date, the most prominent GMO-related issue in the livestock sector has been the use of GMOs in animal feed. Any future moves to expand the use of transgenic animals in agriculture and food production will inevitably bring regulatory issues to the fore.

As part of the legal survey, countries were asked to report on legislation related to the use of transgenic livestock and whether their current legal frameworks have any effect on AnGR and their management. A majority of responding OECD countries (76 percent) reported that they have relevant legislation in place, while 47 percent reported policies. The equivalent figures for non-OECD countries are 41 percent and 27 percent respectively.

The survey responses do not highlight many AnGR-specific issues. Some countries reported that they are in the process of developing legislation related to the use of GMOs in general. Some responses

[152] Available in English at http://www.gnhc.gov.bt/wp-content/uploads/2012/11/RNR-Research-policy-of-Bhutan_28March20121_Cabinet-submitted-version.pdf

[153] Política de Estado para el Sector Agroalimentario y el Desarrollo Rural Costarricense 2010 – 2021 (Versión preliminar | Setiembre 2010) (available in Spanish at http://www.pnp.cr/backend/files/catalogo/8952_MAG-Pol%C3%ADtica%20Agroalimentaria-28092010%20FINALbib.pdf).

[154] Available in English at http://www.fao.org/ag/againfo/programmes/documents/genetics/country_reports/Malaysia_NSAP_Oct2013.pdf

[155] http://www.inia.es/IniaPortal/verPresentacion.action

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note that current frameworks do not specifically address livestock. However, no specific problems related to gaps in existing legislation are mentioned. Some countries report that they have established institutional responsibilities for dealing with the regulation of the use of GMOs in the livestock sector. Costa Rica, for example, notes that the National Animal Health Service has been assigned the task of developing and implementing provisions related to the use, release or commercialization of genetically modified animals – or their products or subproducts – that could present any kind of risk to the environment or to human or animal health.[156] Countries report varying levels of legal restriction on the use of GMOs. The survey response from Austria, for example, states that "the use of genetically modified animals and their products is forbidden in agricultural production in Austria. Imported products containing GMO may be used for feedstuff but must be labelled accordingly."[157] With regard to the effects of these measures, the response notes that "organic farming plays an important role in Austrian agriculture. To further protect the organic sector, use of GMOs in agriculture is not desirable." The response from Norway notes that the country's legal prohibition of the use of GMOs in all food and feed creates problems with regard to the sourcing of feed products, particularly soya beans. However, there is no indication that this has any particular effect on the management of AnGR.

Box 3E11. The regulatory framework for the use of genetically modified organisms in Australia

All dealings with genetically modified (GM) organisms in Australia are regulated by the Gene Technology Regulator under the Gene Technology Act 2000. The Regulator will only grant a licence for the commercial release of a GM crop if it has been assessed as safe for human health and the environment. Every potential licensee must provide the Regulator with an application which is subject to public consultation and a transparent risk assessment process, involving a comprehensive risk assessment and risk management plan. The principals underpinning the risk assessment process are based on international standards originally developed by bodies such as the World Health Organization, the Codex Alimentarius Commission and the Organisation for Economic Cooperation and Development.

Similarly, GM foods are not approved for sale unless they have been assessed as safe for human consumption, and those foods that are approved must be labelled to allow consumers to make an informed choice. GM foods are only approved for sale once assessed as safe by Food Standards Australia New Zealand (FSANZ). To enable consumers to make informed choices GM foods are required to be labelled in accordance with the Australia New Zealand Food Standards Code, administered by FSANZ. The exemptions to the GM labelling requirements relate to food products that do not contain GM material of any type and are therefore indistinguishable from conventionally produced foods, including animals fed on GM feed.

There are no GM animals or animal products currently approved for commercial release in Australia.

Source: Australia's response to the 2013 legal survey.

Access and benefit-sharing

International developments in the field of access and benefit-sharing are described above in the subsection on international legal frameworks. As part of the legal survey, countries were asked about the state of ABS-related legislation and policies at national level and about whether existing or planned instruments include any specific provisions related to AnGR or genetic resources for food and agriculture in general. Previous assessments of use and exchange practices in the AnGR sector

[156] Ley Nº 8.495. Ley general del Servicio Nacional de Salud Animal. *La Gaceta* Nº 93, 16 de mayo de 2006 (available in Spanish at http://faolex.fao.org/docs/pdf/cos78033.pdf).

[157] Verordnung der Bundesministerin für Gesundheit und Frauen über die Kennzeichnung von Erzeugnissen, die aus gentechnisch veränderten Organismen bestehen oder solche enthalten (Gentechnik-Kennzeichnungsverordnung) Bundesgesetzblatt Nr. BGBl. II Nr. 5/2006 (available in German at http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20004526).

(e.g. FAO, 2009c) have generally concluded that few ABS-related problems have arisen, either in terms of potential users being unable to access AnGR or in terms of AnGR being acquired without adequate consent being obtained from, or benefits shared with, the providers. However, they also suggest that some stakeholders have concerns about potential future developments: on the one hand that additional regulations may inhibit or add to the transaction costs of exchanging AnGR and on the other that greater interest in utilizing locally adapted AnGR outside their areas of origin (e.g. as part of climate change adaptation efforts) may lead to inequitable exploitation of these resources.

The survey responses largely reflected the low profile of ABS issues in the AnGR subsector. The proportion of countries reporting that they have ABS-related legislation currently in place was low: 18 percent in OECD countries and 28 percent in non-OECD countries. The figures for policies were 35 percent and 28 percent, respectively. A number of countries, however, reposted that national ABS-related instruments are being introduced or updated in order to enable countries to meet their commitments under the Nagoya Protocol. In the case of OECD countries, of all the topics covered in the survey, ABS was the one for which the largest number of respondents reported that instruments are "in development": 47 percent in the case of legislation and 29 percent in the case of policies. The equivalent figures for non-OECD countries were substantially lower (particularly in the case of legislation) at 10 percent and 21 percent, respectively. Fifty-nine percent of OECD respondents and 31 percent of non-OECD respondents reported that their existing or planned instruments feature at least some provisions specifically targeting AnGR (including exemptions, or potential exemptions, for AnGR from general ABS rules). However, few responses highlight any concrete AnGR-related ABS issues that need or have needed to be addressed at legislative or policy level. A few note the need to develop measures addressing access to genetic material for research purposes or for storage in gene banks (and subsequent extraction of the material for use). Again, however, no specific problems (current or foreseen) are described.

Some survey responses indicate that AnGR are included under ABS-related provisions set out in general instruments on biodiversity. Domesticated animals are, for example, explicitly included within the scope of the Biodiversity Act of Bhutan (2003)[158] and hence within the scope of the ABS-related rules set out in this law. In this case, the provisions allow for the possibility of exemptions for AnGR (and plant genetic resources for food and agriculture) under "special rules and regulations or conditions" where the competent authority deems appropriate.

Legal instruments reported in the survey responses that include provisions specifically related to the export of AnGR include Montenegro's above-mentioned Law on Livestock Farming (2010),[159] which states that "indigenous and endangered indigenous breeds can be exported only if exports do not threaten their numerical strength and their protection, based on authorization from the Ministry." Similarly, Viet Nam's Ordinance on Livestock Breeds (2004)[160] states that "international exchange of precious and rare livestock gene sources" requires permission from the Ministry of Agriculture. Another example is provided in Turkey's country report: a regulation adopted in 2012[161] prohibits the export of AnGR without permission from the Ministry of Food, Agriculture and Livestock. It also requires foreign researchers to obtain permission to use AnGR for research purposes in Turkey and Turkish researchers to obtain permission to use AnGR for research abroad. Export of at-risk AnGR for commercial purposes is forbidden and requests for genetic material from gene banks are not to be accepted if stocks are limited. Export is prohibited unless the prescribed application procedures are followed and a material transfer agreement prepared. China's Stock-Breeding Law (2005) includes the following specific reference to benefit-sharing arrangements: "Where any livestock or poultry genetic resource included in the protection list is to be exported from China or is to be researched and utilized within China in cooperation with any foreign institution or individual, the applicant shall file

[158] Available in English at http://www.icimod.org/resource/2216
[159] Закон о сточарству (available in Montenegrin at http://www.uip.gov.me/ResourceManager/FileDownload.aspx?rid=123075&rType=2&file=Zakon_o_stocarstvu.pdf).
[160] Công Báo No. 16, 24 April 2004, pp. 20–30 (available in English at http://faolex.fao.org/docs/pdf/vie45179.pdf).
[161] Official Gazette of Turkey, No. 28418, 21 September 2012 (available in Turkish at http://www.resmigazete.gov.tr/eskiler/2012/09/20120921-3.htm).

DRAFT - NOT FOR CIRCULATION

an application with the stockbreeding and veterinary administrative department of the provincial people's government and shall simultaneously put forward a plan on sharing the benefits with the state." No survey responses or country reports describe any specific effects that provisions of this kind have had, to date, on the use and exchange of AnGR.

Patenting

International developments with regard to legal frameworks for intellectual property rights in the field of AnGR management are discussed above. The subject was also addressed as part of the legal survey. Countries were asked to provide information on their patent laws, particularly whether they include any provisions specifically related to AnGR or to living organisms in general. Because the questions were clearly interpreted differently by different countries, it is difficult to provide an overview of the findings in quantitative terms. However – whatever the legal framework in the respective country – the survey responses generally indicated that, in the view of the respondents, patent law has had little impact on AnGR management. No specific concerns were raised about existing frameworks. However, some responses noted the need for adaptation or clarification of existing provisions or called for a more homogeneous approach on a global scale.

The responses from several EU member countries refer to the exclusion of "animal varieties" from patentability under the EU directive on the legal protection of biological inventions.[162] Similar exclusions are reported in the responses from a few other countries (e.g. Malaysia and Switzerland). Little information is provided on the effects of these exclusions. In the case of Switzerland, the effects of the existing framework are described as follows: "Respect is given to safety of breeds and genetic diversity, privilege of farmers and breeders is respected, benefit sharing is respected, fundamental research can be done." The response from Austria notes that a change in the law "would have powerful effects on the management of Animal Genetic Resources in EU/Austria" and the need for "decisions in the EU about the legality of future patenting praxis." The response from Bulgaria mentions that under the country's *sui generis* system for livestock breeds (see above), autochthonous breeds are excluded from "authorship claims", which it is noted "can be harmful for the conservation and development of the breed."

3.4. Instruments related to marketing

In most production systems, the management of AnGR is influenced – at least to some degree – by the need to produce goods or services that can be sold at a profit. If a breed's products are difficult to market, it will often become less popular with livestock keepers and, in extreme cases, may fall completely out of use and become extinct. While the basic driving forces of markets are consumer demands and competition among producers, they are also generally regulated, at least to some extent, by legislation and may be influenced by public policies. The main objectives of these instruments are normally to protect the interests of consumers and/or to promote the development of a flourishing livestock sector (or the economy more broadly). However, because they may differentially affect the profitability of different types of livestock production, they have the potential to influence the types of AnGR that are kept by livestock keepers. The discussion presented below in this subsection focuses on effects of the latter type.

Consumer protection

Most if not all countries have some kind of legislation in place that aims to protect consumers by prohibiting the sale of dangerous or defective goods, goods marketed under misleading descriptions and so on. While legislation of this type has no obvious differential effects on the marketing of products from different types of AnGR, it may underpin more specific regulations or initiatives that

[162] Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions (available at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31998L0044).

DRAFT - NOT FOR CITATION

do have such effects. Where animal products are concerned, one of the most significant aspects of consumer protection is food safety. While effective regulation in this field is, clearly, extremely important from the perspective of public health and in terms of consumer confidence in livestock products, food safety laws can create challenges for the producers of certain types of products (including traditional products such as cheeses made from raw milk) or for producers that operate in conditions that make it difficult to comply fully with the relevant rules (e.g. some small-scale livestock keepers). The possibility that effects of this kind might create problems for the marketing of products from at-risk breeds was acknowledged in the ffirst SoW-AnGR. However, there was little to indicate that this was a widespread issue. A small number of responses to the legal survey mentioned problems of this kind. The response from the Czech Republic, for example, states that "the impact appears to be in some respect negative. Compliance with legal measures brings a number of inspections [and] additional administrative burden. It requires technical measures which might be capital intensive. For that reason some farms retreat from keeping animals and [AnGR diversity] decreases." Likewise, the response from Norway notes that "due to high hygienic standards requiring expensive production equipments, these regulations challenge the profit for small-scale entities."

Product traceability

An issue closely related to consumer protection is the question of the traceability of food products of animal origin through all stages of production, processing and distribution, i.e. from the birth of the animal to the sale of the product to the consumer. As noted above, traceability is one of the multiple benefits potentially associated with an effective animal identification system. Traceability is important from the perspective of improving food safety. It can also help to increase consumers' confidence in claims made about the origin of products as part of marketing campaigns. It can, however, create substantial transaction costs. A compulsory traceability system normally requires legal backing to ensure compliance.

Traceability systems and related legal frameworks are widespread in developed countries. EU regulations, for example, are noted above in the subsection on regional frameworks. There is also increasing interest in establishing traceability systems in developing countries. Examples of relevant legislation reported in the responses to the legal survey include the United Republic of Tanzania's Act on Animal Identification and Traceability (2010),[163] Ecuador's Ministerial Accord establishing the Animal Identification and Traceability System (2011),[164] Namibia's Animal Identification Regulations (2009) [165] and Uruguay's Resolution on the Animal Identification and Registration System (2011).[166]

The survey responses do not highlight any particular problems with regard to the effectiveness of existing legislation as a basis for establishing effective traceability systems. However, the response from the United Republic of Tanzania notes that the country's system is new and that more efforts are needed to ensure that it functions properly and is sustainable over the longer term. The indirect effects that the existence of a traceability system has on AnGR management are likely to vary from country to country depending on how it affects market access and demand for various kinds of animal product. The livestock sector in general is likely to benefit from greater consumer confidence and possible opportunities to enter new markets. The survey response from Slovenia, for example, notes that traceability increases buyers' awareness of the origin of food products and increases demand for food from local sources. Presumably this has potential benefits for locally adapted breeds. On the negative side, the response from the Czech Republic notes that, as in the case of food safety regulations, complying with traceability legislation can sometimes be a burden for small-scale producers.

DRAFT - NOT FOR CITATION

[163] Available in English at http://polis.parliament.go.tz/PAMS/docs/12-2010.pdf
[164] Acuerdo Nº 41 – Crea el Sistema de Identificación y Trazabilidad Animal (SITA) (available in Spanish at http://faolex.fao.org/docs/pdf/ecu120083.pdf).
[165] Animal Identification Regulations (GN No. 29 of 2009) *Government Gazette of the Republic of Namibia*, No. 4217 of 5 March 2009 (available in English at http://faolex.fao.org/docs/pdf/nam126791.pdf).
[166] Resolución Nº 11/011 – Sistema de Identificación y Registro Animal (SIRA) (available in Spanish at http://faolex.fao.org/docs/pdf/uru110739.pdf).

Promotion of marketing (mainstream and niche products)

Several countries report that they have policy measures in place supporting the marketing of livestock products. In some cases, these measures have been established on the basis of specific legislation. Some of these policies and laws include provisions related to the marketing of products with specific characteristics that distinguish them from the mainstream (on the basis of geographical origin, production methods, type of animal, etc.). Detailed provisions related to market subsectors may be included in separate instruments. A few survey responses note that "general" laws or policies on marketing do not adequately address the marketing of products from a diverse range of AnGR, either because of omission (a lack of provisions specifically addressing this area) or because the types of products promoted tend to come from a narrow range of "mainstream" breeds. The response from Nepal, for example, notes that a "lack of clear policy for the marketing of animal products specially from the native breeds and of niche products hinders the conservation of animal genetic resources". Likewise, the response from Luxembourg notes that "animal products are to a great extent valued under the national meat quality labels (beef, pork, direct farm sales etc.) or private initiatives. Mostly, conventional intensive beef breeds and pig hybrids are valued under these labels."

Reported examples of marketing laws that address the promotion of niche products include Slovenia's Act on the Promotion of Agricultural and Food Products (2011).[167] Marketing activities within the framework of this law reportedly contribute to increasing product diversity and awareness of "autochthonous and other breeds of AnGR", which in turn helps to keep the breeds in use.

There are a number of specific niche markets that are recognized as having at least some potential as outlets for the sale of products from breeds that are not competitive in mainstream markets. These include the market for organic products, the market for products sold under protected designations of origin (or similar labels that indicate the geographical source of a product or the methods used in its production) and the market for products produced under labels that indicate high standards of animal welfare. The legal survey specifically asked countries to report on laws or policies related to markets of this type.

Organic production. In the case of organic production, all the responding OECD countries and more than 60 percent of responding non-OECD countries reported that they have legislation in place. The sample of countries that responded to the survey appears to be more a little more advanced in this respect than the world as a whole. UNEP (2013) reports that 86 countries have legislation on organic agriculture in place, while another 26 countries are in the process of drafting legislation. A legal framework for organic production normally consists of a set of standards that producers have to follow in order to be permitted to describe their products as organic, arrangements for the certification of organic products and rules related to the use of logos and labels indicating that products are organic. By increasing consumer confidence in organic products and providing protection against fraudulent competition, an effective legal framework increases the likelihood that producers who follow organic standards will be able to make a profit and continue operating. If organic products are produced for export, they normally have to be certified by a certification body that is recognized by the relevant authorities in the importing country (UNEP, 2013). In addition to legislative measures, countries may choose to introduce various kinds of policy measures to encourage or support the development of organic production (support payments, provision of information to producers and consumers, etc.).

Organic standards for livestock production typically include some reference to the type of breeds that are appropriate for use in organic systems. The Codex Alimentarius Commission's Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (FAO/WHO, 2007), for example, state that "the choice of breeds, strains and breeding methods shall be consistent with the principles of organic farming, taking into account in particular: a) their adaptation to the local

[167] Zakon o promociji kmetijskih in živilskih proizvodov (available in Slovenian at http://www.dz-rs.si/wps/portal/Home/deloDZ/zakonodaja/izbranZakonAkt?uid=551989045B5E36FFC1257A63002EF6CD&db=urad_prec_bes&tip=doc).

DRAFT - NOT FOR CITATION

conditions; b) their vitality and resistance to disease; c) the absence of specific diseases or health problems associated with some breeds and strains (porcine stress syndrome, spontaneous abortion etc).” As noted above in the subsection on regional frameworks, the EU regulation on organic production refers to the need to choose breeds that are appropriate to the production conditions. Examples at national level include Canada’s General Principles and Management Standards,[168] which serve as organic standards within the framework of the Organic Products Regulations (2009)[169] and state that “The operator shall ... select breeds and types of livestock that are suitable for site-specific conditions within the local environment and production system and that are resistant to prevalent diseases and parasites ....”

While rules related to the use of well-adapted animals in organic production clearly have some potential to influence AnGR management, in many cases the breeds used in organic production are the same as those used in conventional production in the same geographical area (FAO, 2007). A further point to note is that a well-developed legal framework will not, in and of itself, create a thriving organic sector if consumers have little interest in organic products or are unable to pay the higher prices usually associated with them. Any potential benefits in terms of promoting the sustainable use of AnGR are likely to depend on a number of factors in addition to the legal and policy frameworks.

Among respondents to the legal survey, several European countries indicated that the presence of a legal framework for organic livestock production has some positive effect on the maintenance of breeds that might otherwise be at risk of abandonment. Austria, for example, notes that “one of the major principles of organic livestock farming is to use animal breeds that are adapted to climatic and other local conditions. The organic farming sector in Austria contributes to diversity of farm animals by following [this] principle and by supporting the use of rare animal breeds.” Other examples of countries reporting positive effects include Croatia, the Czech Republic and Germany. Some countries, however, report that effects of this kind are minor (e.g. Cyprus and Norway) or non-existent (e.g. Italy).

Most survey responses from developing countries, even if they indicate that some legal or policy measures are in place, do not mention any particular effect on AnGR management. An exception is the response from Thailand, which notes that its provisions in this field help to promote the conservation of AnGR. The Thai Agricultural Standard for Organic Agriculture (2005) states that “the choice of breeds, strains and breeding technique shall be consistent with the principles of organic agriculture taking into account in particular: their adaptability to the local conditions; the capacity of vitality and resistance to diseases by selection of breeds which are resistant to diseases such as tick-borne disease, etc.”[170] On the policy side, the response from Nepal notes that its Agriculture Policy of 2004 and Poultry Policy of 2011 include provisions related to the marketing of organic products and that some guidelines have also been formulated for the promotion of organic products. While several other developing countries indicate that strengthening the organic sector is regarded as an important objective, little information is provided on the specific legal and policy measures required or on potential effects on the management of AnGR.

Geographical indications. As noted above, another type of niche market that is potentially significant in terms of promoting the sustainable use of breeds that are not competitive in mainstream markets is the market for products sold under protected geographical indications or similar labels. As in the case of organic production, the objective of labelling schemes of this kind is to prevent false claims about the origin of products and thereby ensure that the consumer is not deceived and that genuine producers of the sought-after products can take advantage of whatever price premium

[168] Organic Production Systems General Principles and Management Standards. CAN/CGSB-32.310-2006 (available at http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/programme-program/normes-standards/internet/bio-org/principes-principles-eng.html#a075).
[169] Available at http://laws-lois.justice.gc.ca/PDF/SOR-2009-176.pdf
[170] Thai Agricultural Standard TAS 9000-2005. Organic Agriculture Part 2: Organic Livestock. National Bureau Of Agricultural Commodity And Food Standards Ministry Of Agriculture And Cooperatives (available in English at http://www.acfs.go.th/standard/download/eng/Organic_Agriculture2.pdf).

DRAFT - NOT FOR CITATION

consumers are willing to pay. The significance of niche markets in efforts to promote the sustainable use and conservation of AnGR is discussed in more detail in Part 3 Section [crossref] and Part 4 Section [crossref]. The following discussion focuses on legal and policy instruments.

As described above in the subsection on regional frameworks, several geographical indication schemes have been established under EU legislation. Many EU member countries mention this in their survey responses. The responses suggest that the extent to which the schemes have contributed to keeping potentially threatened breeds in use varies considerably from country to country. However, in most countries such schemes are clearly regarded as valuable or potentially valuable tools for promoting sustainable use and conservation. Some responses mention national schemes (e.g. France's Label rouge)[171] in addition to the EU-level schemes. No particular weakness in existing provisions are highlighted in the survey responses, but several note that the link to specific breeds is usually indirect, i.e. breeds usually benefit because they are associated with the location or production system associated with the indication rather than because their use is mandatory for inclusion in the scheme. Some countries, however, have gone a step further and established breed-specific labelling schemes. Examples of legislation addressing schemes of this type include Spain's Royal Decree 505/2013 Regulating the Use of the Logo "Autochthonous Breed" in Products of Animal Origin (2013),[172] under which breeders' associations for officially recognized autochthonous breeds are able to establish specifications for the use of the logo for their respective breeds. The specifications (minimum contents are set out in an annex to the decree) have to be submitted to the competent authorities for approval.

Provisions related to geographical indications are reported by some non-EU European countries, such as Montenegro[173] and Serbia,[174] but appear to be uncommon in other regions of the world. One exception is Brazil,[175] where products that have a distinct reputation associated with their place of origin and unique qualities associated with local production conditions or know-how can be assigned a registration of geographical indication. Brazil's survey response indicates that by the end of 2013 geographical indications had been granted to two types of cheese (Canatra and Serro) and one type of beef (Pampa Gaúcho).

In some circumstances, a label for a class of products sourced from a particular geographical area and/or produced using specific methods can be established under trademark law. The survey response from Nepal, for example, mentions the labels established for pashminas and for carpets made from the wool of native sheep breeds.

Animal welfare-related labeling. As noted above, another factor that can be highlighted as part of marketing strategies is high animal welfare. Legislation may be necessary in order to ensure that consumers who are concerned about animal welfare (and prepared to pay more for high welfare products) are provided with accurate information that allows them to make informed choices about their purchases. EU legislation, for example, includes provision related to the labelling of eggs as "free range."[176] Potential effects on the management of AnGR arise because the type of animals

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[171] Code rural et de la pêche maritime. Article L641-1 (available in French at http://www.legifrance.gouv.fr/affichCodeArticle.do?cidTexte=LEGITEXT000006071367&idArticle=LEGIARTI000006584662&dateTexte=&categorieLien=cid).
[172] Real Decreto 505/2013, de 28 de junio, por el que se regula el uso del logotipo «raza autóctona» en los productos de origen animal (available in Spanish at http://www.boe.es/boe/dias/2013/07/24/pdfs/BOE-A-2013-8048.pdf).
[173] Ukaz o proglašenju Zakona o oznakama porijekla, geografskim oznakama i oznakama garantovano tradicionalnih specijaliteta poljoprivrednih i prehrambenih proizvoda / Law on Designations of Origin, Geographical Indications and Indications of Traditional Specialities Guaranteed for Agricultural and Food Products. *Official Gazette of Montenegro*, No. 18/11 (available in English at http://www.wipo.int/wipolex/en/text.jsp?file_id=287272 and in the original at http://www.wipo.int/wipolex/en/text.jsp?file_id=249273).
[174] Law on Indications of Geographical Origin. *Official Gazette of the Republic of Serbia*, No. 18/2010 (available in English at http://www.wipo.int/wipolex/en/text.jsp?file_id=186618).
[175] Instrução Normativa Nº 25/2013 Estabelece as condições para o Registro das Indicações Geográficas (available in Portuguese at http://revistas.inpi.gov.br/pdf/PATENTES2230.pdf).
[176] Commission Regulation (EC) No 589/2008 of 23 June 2008 laying down detailed rules for implementing Council Regulation (EC) No 1234/2007 as regards marketing standards for eggs (available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:163:0006:0023:EN:PDF).

suitable for keeping in the different types of production system may vary (e.g. more "robust" animals for outdoor production systems). Legislation that facilitates the marketing of products from higher-welfare (often higher-cost) production systems may help to keep breeds of this type in use. Most instruments in this category reported in the responses to the legal survey focus on organic production rather than on other high-welfare production methods. Several responses recognize that there is some potential for at-risk breeds to benefit from the existence of marketing schemes for high-welfare products, but no specific cases are highlighted. Likewise, few specific gaps in existing legislation are mentioned, although the response from Germany notes the possibility that EU-level legislation regulating the use of voluntary animal welfare labels might be required in the future.

Few responses from developing countries report any legislation in this field or mention it as a priority for the future. Interest appears to be higher in countries that target export markets. Brazil's survey response, for example, while stating that there is no legislation in this field, mentions its Permanent Technical Committee on Animal Welfare, created in 2008, whose duties include legislative alignment of domestic standards with the scientific and criteria established by international agreements to which the country is a signatory, as well as preparing and stimulating the Brazilian agricultural sector to comply with the requirements of Brazil's export markets. The response from Namibia mentions the Farm Assured Namibian Meat Scheme,[177] which combines animal welfare standards with rules on environmental protection, animal identification and traceability and various other aspects of animal husbandry and record keeping.

3.5. Instruments related to animal health and welfare

The first SoW-AnGR concluded that animal health was the most highly regulated aspect of livestock management on a global scale. Most, if not all, countries have put in place legislation that aims to control the spread of livestock diseases within national borders and to prevent the introduction of diseases from outside. Many countries also have established policies or programmes of various kinds that aim to improve the health of their livestock populations. In addition to provisions related to the establishment of relevant institutions (veterinary services and so on), legal frameworks in this field can include provisions that place various restrictions on the activities of livestock keepers and other stakeholders (prohibiting practices that contribute to the spread of diseases) and may also make certain activities that contribute to compulsory disease control (e.g. slaughter and safe disposal of infected animals).

The impacts that policies and legislation in the animal-health field have on AnGR and their management are generally indirect. Control of animal health problems helps to support livestock-keeping livelihoods, to protect animal populations (including at-risk breeds) from the effects of disease epidemics and to facilitate the exchange of breeding animals and genetic material both at national level and internationally. Effective policy and legal instruments that promote animal health can therefore contribute in many ways to the sustainable management of AnGR. Having noted these benefits, it has to be acknowledged that it in some circumstances an improved animal-health situation may facilitate the replacement of locally adapted breeds by disease-susceptible exotic breeds, with potentially negative consequences for diversity. Clearly, this does not mean that animal health-related policies and legislation should be neglected in order to help keep resistant breeds in use. It may, however, be a factor to bear in mind when assessing the effects of livestock sector trends on AnGR management (see Part 2).

Another potentially problematic effect of animal health-related legislation is that it may prescribe the compulsory culling of animal populations affected by (or that have come into contact with) a serious infectious disease. As noted in the first SoW-AnGR, culling campaigns against disease such as foot-and-mouth disease, classical swine fever and African swine fever have led to the extinction of an (apparently) small number of breeds and substantially reduced the population sizes of several others. Less dramatically, legal requirements or restrictions imposed in order to improve disease control may

[177] http://www.nammic.com.na/jdownloads/Manuals/fanmeatmanual.pdf

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make it difficult or costly to continue keeping livestock in certain production systems, with potentially negative consequences for the associated AnGR. A further set of potential problems relate to restrictions on access to breeding material. Such problems are most likely to arise because of zoosanitary controls on imports, but may also occur because of rules related to the movement of animals within the country or to the use of genetic material in the form of semen, embryos, etc. (potentially including material cryoconserved at an earlier time when zoosanitary rules were less strict).

As part of the legal survey, countries were asked to report on their animal-health related laws and policies, including those related to animal identification, the import and export of animals and breeding material, the movement of livestock within the country, the use of reproductive biotechnologies[178] and the control of epidemics through culling.

As discussed above, animal identification systems serve a number of purposes and can contribute in several ways to the management of AnGR. The main initial motivation is often to improve disease control, but systems developed for this purpose can serve other purposes such as facilitating genetic improvement programmes and programmes for monitoring of population trends. Several survey responses note the multiple benefits that can be obtained from having legislation on animal identification in place. All OECD respondents to the survey reported that they have legislation related to animal identification in place, as did more than 50 percent of non-OECD countries, with a further 10 percent reporting that they are developing legislation in this field. Effects on AnGR are generally regarded either as neutral or as positive because the systems help to reduce the threat posed by epidemics.

The survey responses do not highlight any particular problems related to animal identification laws. It is, nonetheless, interesting to note that some issues have arisen in the past. The first SoW-AnGR, for example, noted that some amendments to EU legislation on animal identification had to be introduced to account for the difficulty of attaching ear tags to animals kept in certain extensive production systems within the required time limits after birth.[179] More recently, the survival of certain types of semi-feral pony in the United Kingdom was reportedly threatened by the high costs of compulsory "horse passport" identification documents and microchipping. Derogations, allowable under the relevant EU regulation,[180] were incorporated into national legislation to address the problem.[181]

Many survey responses note that national legislation prescribes compulsory culling in certain circumstances and that this poses a potential threat to AnGR. While some countries' legislation allows for the possibility of derogations to protect at-risk breed populations (reported examples include Finland and Germany), the survey results suggest that provisions of this kind are not widespread. Several countries note the need to review legislation in this field.

A few survey responses mention problems, or potential problems, arising because of zoosanitary restrictions on the import of breeding animals or genetic material. Brazil's response, for example, notes that for many years Brazilian breeders of various zebu cattle breeds were unable to import semen or embryos from India. Spain's response notes that legislation of this kind might hamper the exchange of genetic material and that in the case of transboundary breeds at risk of extinction, simplified mechanisms that facilitate the implementation of conservation programmes need to be developed.

DRAFT - NOT FOR CITATION

[178] The focus in this subsection is on zosanitary issues in the use of reproductive biotechnologies. Other issues are discussed above.

[179] For example, Commission Decision 2004/764/EC of 22 October 2004 concerning an extension of the maximum period laid down for the application of eartags to certain bovine animals kept in nature reserves in the Netherlands (available at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32004D0764).

[180] Commission Regulation (EC) No 504/2008 of 6 June 2008 implementing Council Directives 90/426/EEC and 90/427/EEC as regards methods for the identification of equidae (available at http://eur-lex.europa.eu/legal-content/en/ALL/;jsessionid=T7r8T61HSJVbJSynvk4PR2hhh1d1J3QXNp1ypWtWKPK3nJ596v83!-2051460118?uri=CELEX:32008R0504).

[181] For example: The Equine Identification (Wales) Regulations 2009 (available at http://www.legislation.gov.uk/wsi/2009/2470/made).

With regard to animal movements at country level, the survey response from Brazil notes that when a disease outbreak occurs, restrictions on the movement of breeding animals across state boundaries cause some problems for breeders, but also notes that these restrictions are accepted because breeders recognize the benefits in terms of disease control. The response from Norway reports that "movement of live AnGR within Norway is highly regulated and restricted by law, especially [in the case of] sheep and goats. This makes sustainable breeding a big challenge since it is almost impossible to get 'new' breeding animals to the herd." It further notes that "exemptions based on [the needs of] national AnGR should be accepted within this legislation." Another problem is mentioned in the response from Latvia, which notes that restrictions on marketing imposed in order to control diseases can have a significant effect on livestock keepers' incomes.

A small number of survey responses note that legislation affecting the use of reproductive technologies and frozen genetic material can have implications for cryoconservation programmes. The response from Spain, for example, reports that specific provisions for at-risk breeds are included in its Royal Decree 841/2011 Establishing Basic Conditions for Collection, Distribution and Marketing of Genetic Material from Bovine, Ovine, Caprine and Equine Species.[182]

The legal survey also sought information on instruments related to animal welfare (instruments related specifically to labelling are discussed above in the subsection on marketing). Potential effects of such instruments on AnGR management might arise, for example, because of rules affecting the use of particular reproductive technologies. Indirect effects might arise if production systems have to be adapted in order to account for welfare rules and this in turn leads to changes in the types of AnGR kept. Alternatively, it is possible that activities (e.g. sports) that create demand for particular types of animal might be banned or restricted under welfare legislation.

The survey responses suggest that while many countries have animal welfare legislation and policies in place, impacts on AnGR management are limited (or at least unrecognized). Some responses note that because locally adapted breeds tend to be associated with extensive systems – often regarded as high-welfare systems – the keepers of these breeds may be less likely than the keepers of other breeds to be affected by any financially burdensome welfare-related rules that might be introduced.

3.6. General instruments related to agriculture, land use, rural development and natural-resources management

The final section of the legal survey was devoted to legislation and policies that address "agriculture, land use and natural resources management", i.e. that address the overall management of the production systems, ecosystems and environments within which AnGR are used and developed. The topics covered included very broad fields of action such as agricultural and livestock development, the use of natural resources, environmental protection and management of biodiversity (including wild biodiversity), as well as some more specific topics such as the management of natural and human-induced disasters.[183] In this context, influences on AnGR and their management may be direct or indirect. One the one hand, a law or policy may have an impact because of specific provisions related to AnGR, i.e. AnGR have (to some degree) been "mainstreamed" within the respective field. On the other, a policy or law that does not include a specific reference to AnGR may have an inadvertent effect (positive or negative) on AnGR (e.g. by promoting or constraining the operation of different types of livestock production that tend to use different types of AnGR).

The various topics addressed in this part of the survey (and below in this subsection) are closely inter-related. The "architecture" of legal and policy frameworks addressing them (e.g. whether topics are addressed separately or under broad all-encompassing instruments) inevitably varies from country to country. The absence of a specific instrument does not necessarily mean the topic is being neglected.

[182] Real Decreto 841/2011, de 17 de junio, por el que se establecen las condiciones básicas de recogida, almacenamiento, distribución y comercialización de material genético de las especies bovina, ovina, caprina y porcina, y de los équidos (available in Spanish at http://www.boe.es/boe/dias/2011/07/14/pdfs/BOE-A-2011-12107.pdf).

[183] For a discussion on policy and legal instruments in the latter field, see Part 1 Section [crossref] (Threats to AnGR).

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For some categories, it is therefore not particularly informative to present quantitative figures for the proportion of countries having instruments in place. The survey questionnaire was, however, arranged topic by topic (proceeding roughly from the broader to the narrower), with the aim of eliciting as much information as possible. The description below is structured in a similar way.

Agriculture and rural development

The management of AnGR is closely entwined with the management of a range of other natural resources and with many aspects of agricultural and rural development. These resource-use and developmental issues are likely to be major themes of interest for national governments and therefore targeted by legal and policy measures of one kind or another. Growing concerns about the harmful effects that agriculture can have on the environment and growing awareness of the importance of ecosystem services used in agriculture and produced in agricultural systems have contributed to a growing interest in a more integrated approach to these issues at policy level.

As described above in the subsection on regional frameworks, measures that address interactions between agriculture and the environment are a significant feature of policies and legislation at EU-level. All EU member countries developed national rural development strategy plans for the 2007 to 2013 period. Most of the policies of this type reported in the survey responses were also from European countries (including both members and non-members of the EU). Examples include the New Hungary Rural Development Programme,[184] which included an action on "Preservation of native and endangered farm animal genetic resources through breeding" under which livestock keepers who raise a "protected native or endangered farm animal breed" and adhere to rules regarding herd book registrations and the mating plans prescribed in the breeding programme are eligible to receive support payments in line with the rules set out in the relevant EU legislation.[185]

In some circumstances, the recognition of AnGR issues in a broad rural development programme may provide a framework for the development of a national strategy and action plan specifically for AnGR. For example, Montenegro's Action Plan for the Conservation of Genetic Resources in Agriculture[186] (published in 2008) was foreseen in the country's Agriculture and Rural Development Strategy (2006).[187]

The extent to which agri-environmental schemes affect the management of AnGR indirectly by influencing trends in livestock-sector development is not easy to assess. However, the inclusion of measures aimed at supporting livelihoods in more remote and "marginal" areas, the diversification of the rural economy and the use of grazing livestock to provide various ecosystem services implies some potential for positive outcomes in terms of promoting the use of more diverse livestock populations. One example is given in the survey response from Luxembourg, which states that although the country's rural development programmes are "not particularly aimed at conserving farm animal genetic resources", they include measures aimed at protecting forest soils against compaction, including support for the use of horses for work in the forests – a task for which the rare Ardennes horse is reportedly well suited.

Legal instruments in this field reported in survey responses from non-European countries tend to be less focused on the multiple functions of agriculture and its multiple impacts on ecosystem function.

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[184] New Hungary Rural Development Programme NHRDP Version 9, amended according to EC comments Ares(2012)796680_02072012 – February 2013 (available in English at www.mvh.gov.hu/MVHPortal/files/1039501_NHRDP_version_9pdf).

[185] Council Regulation 1974/2006/EC, of 15 December 2006 laying down detailed rules for the application of Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) (available at http://faolex.fao.org/docs/pdf/eur68184.pdf).

[186] Akcioni plan očuvanja genetičkih resursa u poljoprivredi (2009 – 2013) (available in Montenegrin at http://www.fao.org/ag/againfo/programmes/documents/genetics/country_reports/NSAP_Montenegro_adopted_July2008.pdf).

[187] Montenegro's agriculture and European Union. Agriculture and rural development strategy. Final report of the EU funded project (available in English at http://www.minpolj.gov.me/ResourceManager/FileDownload.aspx?rid=50152&rType=2&file=1193065854.pdf).

They generally do not include specific provisions related to the sustainable use or conservation of AnGR. The focus is often on the sustainable use of specific natural resources that underpin agriculture (water, soil, etc.), access to these resources, land-use planning and/or establishing the institutional framework for the management and development of the agricultural sector. Reported examples include Uruguay's Law on Land Management and Sustainable Development (2008)[188] and Sri Lanka's Agrarian Development Act (2000).[189] Ecuador's Organic Law on Food Sovereignty[190] explicitly refers to the multiple social and environmental considerations that have to be accounted for in land use and to the importance of maintaining ecological functions. It also refers explicitly to the conservation of agrobiodiversity, although the focus is largely on plants. Any effects on AnGR management reported in the survey responses are indirect: sustainable management of AnGR can only occur in sustainable production systems. For example, the response from Burundi mentions (*inter alia*) laws on the management of soil[191] and water[192] and notes that "land and water are key issues in the management of genetic resources."

Among reported policy instruments, Costa Rica's State Policy for the Food and Agriculture Sector and Rural Development 2010–2020[193] includes (in addition to the above-mentioned provisions on AnGR-related research) a section on agrobiodiversity, which – interestingly from the perspective of this chapter – calls for an exhaustive analysis of the country's legislation on genetic resources and intellectual property and the establishment of a national plan for their application. It also calls for efforts to strengthen the conservation and use of plant and animal genetic resources, emphasizing collaborative and interdisciplinary approaches within the frameworks of national programmes for the two subsectors and the respective global plans of action. A section on climate change adaptation emphasizes the importance of *in situ* and *ex situ* conservation of crop, livestock and fish genetic resources.

Livestock-sector development

The legal survey also asked countries about instruments specifically focusing on the overall development of the livestock sector. These would typically be national livestock-development strategies or plans or legal instruments of similar scope. Few of the survey responses indicate that broad livestock-sector policies include any provisions related to promoting the sustainable use, development or conservation of AnGR. The picture provided by the country reports is, however, rather more positive. Sixty-five percent of countries report that they have livestock development strategies or plans that address AnGR management and a further 12 percent that the topic will be addressed in a forthcoming plan. The region with the highest proportion of countries (83 percent) reporting such policies is Africa. In many cases, little information is provided on the content or state of implementation of these policies. It is not safe to conclude that all are having a positive effect on AnGR management. Nonetheless, a number of the policy documents referred to in the reports include substantial provisions related to the sustainable use, development and conservation of AnGR and of locally adapted breeds in particular.

Kenya's National Livestock Policy (2008),[194] for example, includes a section on AnGR that contains plans, *inter alia*, for the implementation of demographic surveys of AnGR, the development of

[188] Ley Nº 18.308 Ordenamiento territorial y desarrollo sostenible (available in Spanish at http://www.parlamento.gub.uy/leyes/AccesoTextoLey.asp?Ley=18308&Anchor).
[189] Agrarian Development Act, No. 46 of 2000 (available in English at http://faolex.fao.org/docs/pdf/srl43285.pdf).
[190] Ley Orgánica del Régimen de la Soberanía Alimentaria 2009 (available in Spanish at http://www.soberaniaalimentaria.gob.ec/?page_id=132#sthash.MC9aPFkS.dpuf).
[191] Décret du 26 novembre 1958 sur la conservation et utilisation des sols (available in French at http://faolex.fao.org/docs/pdf/bur39375.pdf).
[192] Loi n°1/02 du 26 mars 2012 portant code de l'eau au Burundi (available in French at http://faolex.fao.org/docs/pdf/bur129952.pdf).
[193] Política de Estado para el Sector Agroalimentario y el Desarrollo Rural Costarricense 2010 – 2021 (available in Spanish at http://www.mag.go.cr/bibliotecavirtual/a00289.pdf).
[194] Available at http://kenyavetboard.org/index.php/publications/category/2-acts-and-policies?download=7:national%20livestock%20policy

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guidelines on appropriate matching of breeds and production environments, the strengthening of various aspects of the organizational infrastructure for breeding programmes, including animal registration and recording schemes, breeders' associations and the delivery of breeding services, such as artificial insemination, and the establishment of breeding programmes for locally adapted breeds (see Box 3E13 for further information). As another example, India's National Livestock Policy (2013)[195] sets out breeding policies for all the main species of (mammalian) livestock present in the country, with varying degrees of emphasis given to the development of locally adapted breeds. Other elements of the policy include promoting the use of reproductive biotechnologies and the implementation of conservation measures including the provision of support to migratory pastoralist communities that manage breeds of "buffaloes, sheep, goats, yaks, etc." Several countries report that although policies exist their implementation is weak or that general provisions related to AnGR management need to be elaborated in more detail. South Africa mentions that both its National livestock Development Strategy and its Animal Improvement Policy (2006)[196] promote the sustainable use of AnGR and are linked to the country's Animal Improvement Act (1998)[197] (Act 62 of 1998). Both policies were reported to be undergoing revision in parallel to the second SoW-AnGR reporting with the aim of ensuring consistency among the instruments and their relevance under changing circumstances, "including climate change and climate smart animal agriculture."

Box 3E12. Animal genetic resources management in Kenya's National Livestock Policy

The Kenya National Livestock Policy (2008) was formulated with an aim of addressing the challenges facing the livestock subsector in the fields of breeding, nutrition and feeding, disease control, value addition and marketing, and research and extension. Specific objectives include establishing appropriate management systems for sustainable development of the livestock industry, effectively improving and conserving available animal genetic resources (AnGR); achieving effective control of animal diseases and pests, ensuring the safety of foods of animal origin, and focusing research efforts in the livestock subsector on resolving current and emerging problems.

With regard to the management of AnGR, the policy addresses, or intends to address, characterization, inventory and documentation, sustainable use and conservation of indigenous AnGR. Specific achievements attributable to the National Livestock Policy include:

1. the establishment, through a legal notice, of the Kenya Animal Genetic Resources Centre, which is tasked with establishment, under the guidance of the National Animal Genetic Resources Advisory Committee, of a gene bank that will take custody of tissues, DNA, semen and embryos from all important livestock and emerging livestock species in Kenya; the material will be conserved for posterity and made available for research and breeding as deemed appropriate;
2. conversion of livestock farms and sheep and goat stations into conservation farms for breeds that are considered vulnerable, especially those threatened by cross-breeding and natural disasters;
3. the collection of livestock data as part of the 2009 human population census, which provided livestock populations by species; an agriculture census is planned for 2015, and if it takes place, will provide information about the AnGR in Kenya;
4. regulation of all breeding-service providers and the establishment of farmer groups, cooperatives and other community-based structures to provide artificial insemination services;
5. increasing financial support for livestock registration and performance recording by the government;
6. allocation of additional funds by the government for the commercialization of indigenous chickens and for upgrading the Rabbit Multiplication Centre; and
7. establishment of a livestock insurance scheme.

Implementation has enhanced awareness among the public and among government officials regarding the need to manage AnGR sustainably. Pastoralists have become more involved in conservation

[195] Available at http://dahd.nic.in/dahd/WriteReadData/NLP%202013%20Final11.pdf
[196] Animal Improvement Policy for South Africa. Notice 165 of 2007. *Government Gazette*, No. 30459 (16 November 2007: 41–66 (available at http://govza.gcis.gov.za/sites/www.gov.za/files/30459_1652_1.pdf).
[197] Animal Improvement Act, 1998 (No. 62 of 1998) (available at http://faolex.fao.org/docs/pdf/saf17623.pdf).)

efforts for breeds such as the Red Maasai sheep. This came about when some of them realized that if they cross-breed all their flocks, they lose them all whenever there is the severe drought, while the Red Maasai animals survive. The policy is also intended to contribute to development of breeding programmes for indigenous AnGR.
The policy was developed with the participation of key livestock-sector stakeholders. Their views were gathered via workshops arranged in various parts of the country and later via a national forum. The draft policy was presented to the Cabinet and finally passed by the Kenyan Parliament.

Provided by Cleopas Okore National Coordinator for the Management of Animal Genetic Resources, Kenya.

As far as the indirect effects on AnGR management are concerned, there are indications in the responses to the legal survey suggest that livestock development policies can have both positive and negative effects on diversity. The response from Mauritius, for example, notes that the country's livestock policy aims to increase its "self-sufficiency in certain commodities for certain commodities through the provision of imported animals with better production potential as well as infrastructure and equipment." The consequence of this for AnGR is that "exotic animals with higher production potential are being favoured at the expense of local animals and their crosses." The response from Suriname, however, notes the existence of breeding, livestock management and livestock extension policies that target small-scale farmers in low external input production, and that within these policies "local genetics are sometimes the choice."

Management of biodiversity

The next topic explored in the legal survey was legislation and policies addressing the management of biodiversity (i.e. biodiversity as a whole rather than agricultural biodiversity or AnGR in particular). From the AnGR management perspective, the main questions of interest with regard to these instruments are: whether they include any provisions directly related to promoting the conservation and sustainable use of AnGR; whether they include any provisions that may indirectly affect AnGR management (e.g. by restricting the use of grazing animals in protected areas); and whether they include any provisions that affect access to AnGR or the sharing of benefits derived from their use (this issue is discussed above).

National policies on biodiversity are very widespread. As of April 2014, National Biodiversity Strategies and Action Plans (NBSAPs) (the principal instruments for implementing the CBD at national level) had been developed by 179 countries.[198] To assess the extent to which these plans address the management of AnGR, the 174 NBSAP documents available on the CBD website in April 2014 were searched using relevant keywords. Based on the results of this search and the information provided in the country reports, the plans could be roughly grouped into the following three categories: no mention of AnGR (18 percent); AnGR explicitly included in the scope of the plan, but no AnGR-focused activities mentioned (13 percent); AnGR-focused actions mentioned (69 percent). The practical impact of these AnGR-related provisions is difficult to assess, but is not necessarily very large. For example, Austria's response to the legal survey states that "the Austrian National Biodiversity Strategy has little impact on the management of animal genetic resources."

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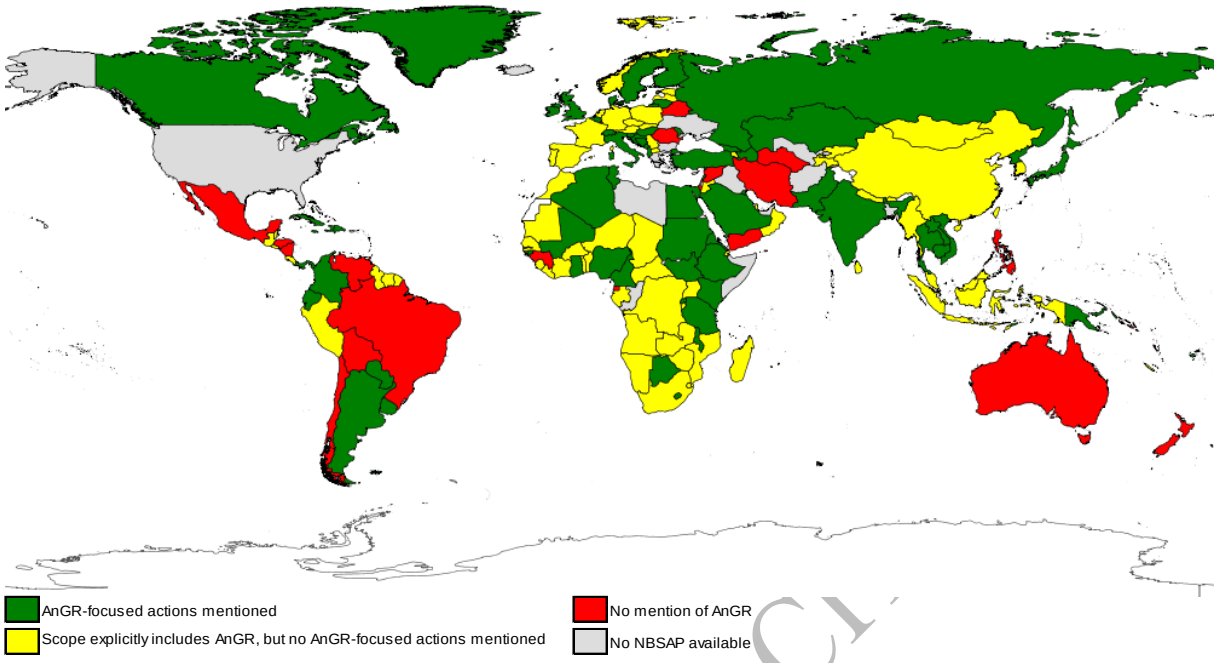
[198] http://www.cbd.int/nbsap/

Figure 3E3. Inclusion of animal genetic resources issues in national biodiversity strategies and action plans



Note: Analysis based on national biodiversity strategies and action plans available on the web site of the Convention on Biological Diversity (www.cbd.int/nbsap) (accessed in April 2014).

The survey responses indicate that legislation targeting the management of biodiversity is also widespread. More than 80 percent of OECD countries and almost 70 percent of non-OECD countries report that they have legislation in place (Figure 3E1). Several responses indicate that the conservation of AnGR is explicitly included within the scope of national biodiversity legislation. For example, the Biodiversity Act of Bhutan (2003)[199] states that "This Act shall apply to all the genetic and biochemical resources including wild, domesticated and cultivated species of flora and fauna, both *in-situ* and *ex-situ* conditions found within the territory of [the] Kingdom of Bhutan." Norway's

Nature Diversity Act (2009) [200] states that "The genetic diversity of domesticated species shall be managed in such a way that it helps to secure the future resource base" and further that "The King may make regulations regarding special conservation measures for domesticated species ..." Other reported examples in which AnGR are explicitly mentioned as targets for conservation measures are the biodiversity laws of Viet Nam (2008)[201] and Costa Rica (1999).[202] However, the survey responses provide little information on practical effects that instruments of this type have on AnGR management. Likewise, little information is provided on any priority requirements in terms of developing new instruments or improving existing ones. A few of the reported legal instruments include provisions allowing for restrictions to be imposed on the use of grazing animals in circumstances where they are regarded as a potential threat to biodiversity. None of the survey responses, however, indicated that such instruments caused any problems for AnGR management (see, however, Box [crossref] in Part 1 Section [crossref]).

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[199] The Biodiversity Act of Bhutan, Water Sheep Year 2003 (available in English at http://www.nationalcouncil.bt/wp-content/uploads/2011/02/Biodiversity_En_03.pdf).
[200] Act of 19 June 2009 No. 100 Relating to the Management of Biological, Geological and Landscape Diversity (Nature Diversity Act) (available in English at http://www.regjeringen.no/en/doc/laws/Acts/nature-diversity-act.html?id=570549).
[201] Luật số 20/2008/QH12 của Quốc hội : LUẬT ĐA DẠNG SINH HỌC (Law No. 20/2008/QH12. Biodiversity Law) (available in Vietnamese at http://www.chinhphu.vn/portal/page/portal/chinhphu/hethongvanban?class_id=1&mode=detail&document_id=81137 and in English at http://moderncms.ecosystemmarketplace.com/repository/moderncms_documents/finallaw_engpassedbyna.doc).
[202] Ley de Biodiversidad (available in Spanish at http://www.eefb.ucr.ac.cr/Repositorio%20de%20documentos/costarica-leybiodiversidad-1998-sp.pdf).

Environmental protection and planning

Another field of legislation and policy that can affect the development of livestock production systems and hence indirectly affect the management of AnGR is environmental protection. As described above, instruments focusing on biodiversity were treated as a separate category in the legal survey. The category "environmental protection" was therefore intended to catch instruments related to other environmental issues such as the pollution of land, air and water. While a large majority of responding countries reported that they have legislation and policies relating to environmental protection in place, few mentioned any impacts on AnGR management. However, there were some exceptions. France, for example, notes that its National Plan on Climate Change Adaptation[203] and legislation on water management have affected the availability of animal feed (e.g. in some areas a reduction in the availability of forage maize and increase in the proportion of grass in the diet). These changes, in turn, are reported to affect AnGR management: they may favour the use of breeds that make good use of grass-based diets. Similarly, France's "Écoantibio" plan (National Action Plan for the Reduction of Risks of Antibiotic Resistance in Veterinary Medicine)[204] is reported to have led breeders to pay greater attention to "rusticity" and disease resistance.

Rules related to the establishment of livestock farms and holdings – another category addressed in the legal survey – can target a range of concerns including environmental, zoosanitary and animal welfare-related matters. Where regulations are in place, farmers and livestock keepers typically have to register their holdings and comply with certain minimum standards. The survey responses indicate that legislation of this type is widespread. Some mention that regulations can constrain the establishment, operation or expansion of livestock holdings. However, no examples of significant effects on AnGR management are reported. Several responses note that small-scale holdings where locally adapted breeds tend to be kept are less strictly regulated than larger holdings. The country report from Norway notes that the "production of pork and poultry has since 1975 been legally regulated by a concession act. This act aims to avoid the development of industrial-type animal production in the most concentrate-intensive production systems. The accepted upper limit of herd sizes [was] ... increased in 1992, 1995, 2003 and 2013."

Rangeland management

Another area in which environmental concerns interact with livestock development is rangeland management. Access to grazing land is vital to many livestock-keeping livelihoods – and by extension to the maintenance of many breeds. This is one of the few fields of action in which the results of the legal survey suggest that legislation is more prevalent in non-OECD than in OECD countries. This is probably because land-ownership systems other than straightforward private ownership (under which management and access is largely a matter for the individual owner) are more widespread in non-OECD countries.

While livestock-keeping communities often have – or used to have – traditional mechanisms for regulating access to grazing land, in recent decades (in some cases over a longer period) legislation has come to play an increasing role in rangeland management. Several examples of national legislation were noted in the first SoW-AnGR.[205] Because they directly affect access to productive resources, laws and policies in this field are potentially more controversial than some of the other types of legislation discussed in this section. While stated objectives, such as promoting the sustainable use of grazing land, typically appear to favour the sustainable use of AnGR, detailed provisions – or the details of implementation – may or may not favour the continuation of livestock-keeping livelihoods and practices that support the maintenance of locally adapted breeds.

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[203] Plan national d'adaptation de la France aux effets du changement climatique 2011 – 2015 (available at http://www.developpement-durable.gouv.fr/IMG/pdf/ONERC-PNACC-complet.pdf).
[204] Plan national de reduction des risques d'antibiorésistance en médecine vétérinaire (available in French at http://agriculture.gouv.fr/IMG/pdf/PlanABR-FR-2012-BD_cle8fc22e.pdf and in English at http://agriculture.gouv.fr/IMG/pdf/130208PlanABR-GB-2012-BD_cle8786a1.pdf).
[205] Pages 310–311.

In so far as the survey responses provide any information on the consequences of legislation in this field for AnGR management, they note positive outcomes. The responses from several European countries (e.g. France, Hungary and Latvia) note that increased interest, at policy level, in the protection of permanent meadows and other grassland habitats has created opportunities for keeping locally adapted breeds in use. It should, however, be noted that some criticism has been levelled at existing legislation in this field. Hesse and Thebaud (2006), for example, argue that while the pastoral laws adopted in several West African countries during the 1990s and early 2000s include a number of positive features, their complicated bureaucratic mechanisms, and sectoral approaches that artificially divide local livelihood systems, have the potential to disempower pastoralist communities and undermine their grazing-based livelihood strategies. Legal frameworks and policies in West Africa have, nonetheless, been described as "more favourable" to pastoralism than those in East Africa, which reportedly tend to favour sedentarization (Inter-Résaux, 2012). The African Union's Policy Framework for Pastoralism in Africa (African Union, 2013) notes positive trends in pro-pastoral policies and legislation in Africa, but recognizes that major challenges remain. Appropriate legislation – accompanied by institutional and operational measures – is recognized as an essential component of efforts to improve pastoral policies. Specifically, it is recognized that there is a need to secure "access to rangelands for pastoralists through supportive land tenure policies and legislation, and further development of regional policies to enable regional movements and livestock trade" (ibid.).

Stakeholder participation

A further issue addressed in the legal survey was the question of stakeholder participation. Countries were also asked to provide information on legal and policy frameworks promoting the participation of livestock keepers in decision-making related to livestock sector development. Instruments of this type are reported to be widespread. In some cases, the survey responses indicate that even though there is no legislation or formal policy in place, frequent consultations with a range of stakeholders take place. The effects on AnGR management are generally reported to be positive, although as discussed in Part 3 Section [crossref], many countries acknowledge that much remains to be done to improve stakeholder participation in AnGR management.

The legislation reported in this category includes general instruments related to the participation of citizens in the development of national laws and policies (e.g. Slovenia's Resolution on Legislative Regulation of 2009), [206] instruments related to the organization of research and development programmes (e.g. Australia's Primary Industries and Energy Research and Development Act of 1989), [207] instruments addressing the development of the agricultural sector (e.g. Spain's Royal Decree 822/2010)[208] and instruments specifically focusing on livestock breeding (e.g. Bulgaria's Animal Breeding Law of 2000, as amended in 2010). [209] Several survey responses describe institutional frameworks for the participation of livestock keepers and other stakeholders in decision-making processes without providing details of the legal and policy instruments (if any) that underpin them. Frameworks of this kind, and the general topic of stakeholder participation, are discussed further in Part 3 Section [crossref]. Several survey responses from countries where there are no instruments in place report the need to strengthen participation, although not necessarily through the development of a formal instrument.

In this context, it is important to note that the link between legal and policy frameworks and stakeholder participation is often a two-way relationship: not only may laws and policies help to promote participation, but appropriate stakeholder participation may help to create more appropriate

[206] Resolucija o normativni dejavnosti (ReNDej) (available in Slovenian at http://www.uradni-list.si/1/objava.jsp?urlid=200995&stevilka=4117, 24.11.2009).
[207] Available at http://www.comlaw.gov.au/Series/C2004A03948
[208] Real Decreto 822/2010, de 25 de junio, por el que se aprueba el Reglamento de desarrollo de la Ley 10/2009, de 20 de octubre, de creación de órganos consultivos del Estado en el ámbito agroalimentario y de determinación de las bases de representación de las organizaciones profesionales agrarias (available in Spanish at http://www.boe.es/boe/dias/2010/07/15/pdfs/BOE-A-2010-11182.pdf).
[209] Закон за животновъдството в сила от 09.09.2000 г. (available in Bulgarian at http://tinyurl.com/qejpg4a).

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laws and policies and facilitate their implementation. For example, the country report from Botswana, commenting on AnGR-related laws, notes that "farmers feel that they are more of recipients of these laws, as they are seldom consulted ... [and enabled to have an] input in the law-making process."

4. Changes since 2005

Because of differences in the approaches to data collection and the number of countries that participated, it is not possible to compare the figures presented above directly to those presented in the equivalent chapter of the first SoW-AnGR. It is also not possible, based on the survey results, to provide a detailed analysis of how many countries have developed legal and policy instruments in specific fields during the 2005 to 2013 reporting period. The main indicators that progress has been made are the substantial proportion of countries (particularly non-OECD countries) that reported that they are in the process of developing legal or policy instruments and (less quantifiably) the numerous post-2005 instruments presented as examples above.

The country-report questionnaires requested countries to provide some information on the general state of their legal and policy frameworks. In response to a question about progress since the adoption of the Global Plan of Action, 20 percent of countries reported that progress had been made in this field (in addition to 23 percent that stated that they already had comprehensive legislation and policies in place already before 2007) (Table 3E2). In addition, as part of the assessment of institutions and capacities (see Part 3 Section [crossref]), countries were asked to score (none, low, medium or high) the current state of their legal and policy frameworks and the state of implementation of these frameworks. For the first SoW-AnGR, countries were assigned scores based on the information provided in their country reports.[210] Clearly, the two sets of scores are not directly comparable. As well as being affected by differences in methodology, the differences between the two sets of scores may reflect changes in countries' objectives and "ambitions" over the years. With these caveats, the findings appear to indicate positive developments overall. Out of 110 countries that were included in both scoring exercises, far more increased their scores (between 45 percent and 48 percent in the various categories) than decreased their scores (between 13 percent and 16 percent) between 2006 and 2013/2014.[211]

Table 3E2. Reported progress in the development of legal and policy frameworks since the adoption of the Global Plan of Action for Animal Genetic Resources

	Number of country reports	Comprehensive framework before GPA adoption	Progress since GPA adoption	No progress since GPA adoption
Africa	40	10%	18%	72%
Asia	20	10%	40%	50%
Europe and the Caucasus	35	54%	26%	20%
Latin America and the Caribbean	18	11%	6%	83%
Near and Middle East	7	0%	14%	86%
North America	1	100%	0%	0%
Southwest Pacific	7	14%	0%	86%
Total	128	23%	20%	57%

While it appears that progress has been made, the country reports indicate that a large proportion of countries still consider their legal and policy frameworks – and the state of implementation of these

[210] Table 58 of the first SoW-AnGR (pages 207 to 213). In this case, scores were allocated jointly for laws and policies.
[211] For state of legislation: 45 percent with an increased score vs. 16 percent with a decrease. For state of policies: 46 percent with an increased score vs. 13 percent with a decrease. For implementation of legislation: 48 percent with an increased score vs. 15 percent with a decrease. For implementation of policies: 48 percent with an increased score vs. 14 percent with a decrease.

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frameworks – to be inadequate. There is some indication that mainstreaming of AnGR into wider legal and policy frameworks (e.g. livestock sector development strategies and national biodiversity strategies and action plans) has become more widespread, but the practical consequences of this are as yet unclear. The number of national strategies and action plans developed in recent years also indicates that additional attention is being paid to AnGR management at policy level. However, most of these instruments are at an early stage of implementation.

Interest in the development of AnGR-related legal measures is widespread. However, the question raised in the first SoW-AnGR about whether elaborate legal frameworks are always necessary or appropriate remains to be resolved. It is not clear, based on the country reports and responses to the legal survey, that all countries have adequately assessed the impact of their current legislation (or lack of legislation) on AnGR management or developed a clear vision of their future needs in this field. Where this is the case, the Global Plan of Action's recommendation of the regarding the need to conduct "periodic reviews" of legal and policy frameworks to identify effects on AnGR management and, if necessary, steps that can be taken to improve the situation remains relevant.

5. Gaps and needs

The results of the legal survey give an indication (based on a limited sample of countries) of which areas of AnGR management are well covered by laws and policies and which are not. However, the extent to which specific gaps in this coverage represent significant constraints to AnGR management on a global scale is difficult to estimate. Priorities for improving national legal and policy frameworks have to be developed at country level based, on careful assessments of national needs and circumstances. Some country reports suggest that weaknesses in policy- and law-making processes constitute a bottleneck that inhibits progress towards better AnGR management. Perhaps the most significant of these weaknesses is a lack of stakeholder participation, but a lack of expertise in the formulation of legal instruments is also an issue for some countries.

The country reports note a number of different factors that contribute to problems with the implementation of policy and legal frameworks. These include a lack of human and financial resources, logistical problems, lack of coordination between different departments, excessive bureaucracy, lack of awareness on the part of stakeholders, lack of clarity in the formulation of legal and policy texts, and lack of harmony between the procedures envisaged in such texts and the administrative arrangements through which they are meant to be implemented. Addressing some of these constraints may be relatively straightforward given the necessary political will, but others may be difficult to overcome, at least in the short to medium term. A realistic assessment of what is feasible and what policy and legal tools are appropriate in national circumstances is likely to be important. The process of developing, or where relevant reviewing and updating, national strategies and action plans for AnGR (FAO, 2009a) may provide countries with the opportunity to assess the state of their existing policy and legal frameworks in consultation with a range of stakeholders and identify any changes that may be required.

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