Section D

Conservation programmes

1 Introduction

This section presents a review of the state of conservation programmes based on information provided in the country reports (see the introduction to Part 3 for an overview of the country coverage and the use of the national breed population as a unit of analysis). 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 D 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 bred.
- ***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 at a later date.

The section is structured as follows. Subsection 2 presents an overview of the state of conservation programmes worldwide. Subsections 3 and 4 discuss *in situ* conservation programmes in more detail, including an analysis of the types of activities undertaken and whether they are managed by the public or private sectors. Subsection 5 discusses *ex situ in vitro* conservation programmes in greater depth, including an analysis of the types of material stored and the breed coverage. Subsection 6 presents a region by region overview of the state of conservation programmes. Subsection 7 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 SoW-AnGR) (FAO, 2007a) was prepared. The final subsection presents some conclusions and discusses priority actions that need to be taken in order to improve the state of conservation programmes worldwide.

2 Global overview

A comprehensive assessment of the state of global provision of conservation programmes would require breed-by-breed data on the presence or absence (and if present the effectiveness) of the various types of conservation programme that can be implemented, as well as on the risk status of the respective breeds. Requiring the inclusion of breedwise data on conservation activities in the country reports was not considered to be feasible (the major gaps that exist in risk-status data are discussed in Part 1 Section B). The country-report questionnaire therefore 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 3D1). *In situ* conservation programmes are reported by all countries in Europe and the Caucasus, Central Asia, East Asia and North 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.

Ex situ conservation programmes are less common than *in situ* programmes: 60 percent and 54 percent of countries report *ex situ in vivo*

TABLE 3D1
Proportion of countries reporting conservation activities

Regions and subregions	Number of countries	*In situ* conservation programmes	*Ex situ in vivo* conservation programmes	*Ex situ in vitro* conservation programmes
		%		
Africa	**40**	**70**	**48**	**30**
East Africa	8	75	63	50
North and 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 and the Caucasus	**35**	**100**	**69**	**86**
Latin America and 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 and Middle East	**7**	**71**	**71**	**29**
World	**128**	**84**	**63**	**55**

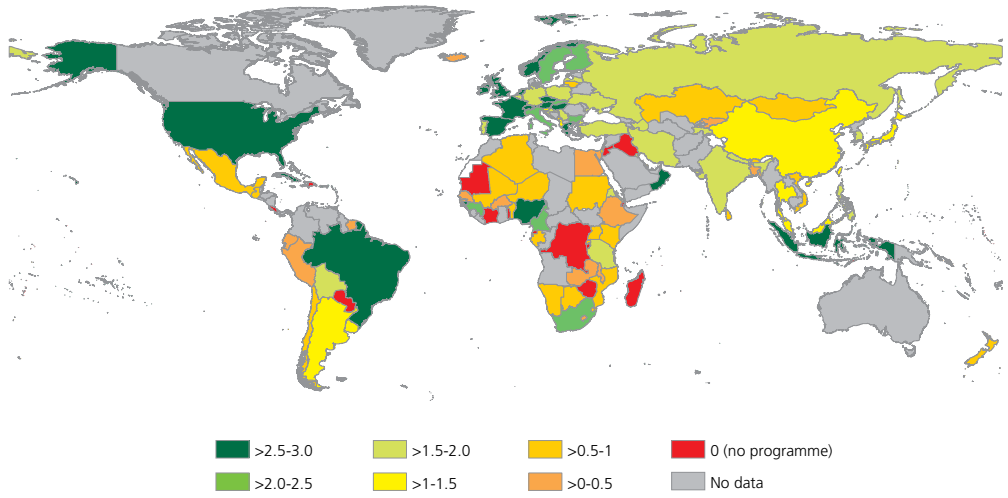
Note: Figures refer to the proportion of countries reporting conservation activities for at least one species.
Source: Country reports, 2014.

and *ex situ in vitro* programmes, respectively. The figures are particularly low in the Southwest Pacific (29 percent and 14 percent). However, 100 percent of East Asian countries report 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 indicate that in many countries programmes are far from comprehensive. This is illustrated, for example, by Figure 3D1, which shows average national breed coverage scores for *in situ* programmes at country level (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 3D2. 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 *ex 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. This is probably explained by the fact that if effective *in situ* and *ex situ in vitro* programmes are in

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

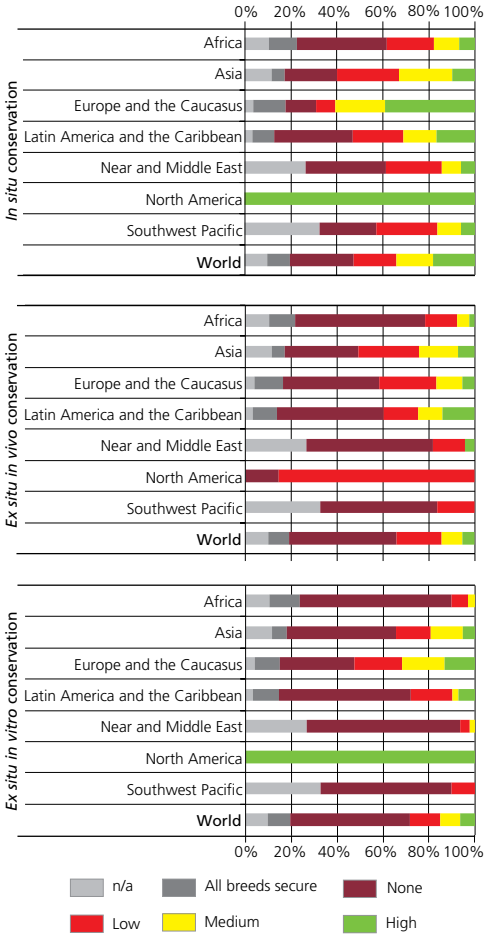
FIGURE 3D1
Coverage of *in situ* conservation programmes for the big five livestock species



Note: 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 for all the species/categories reported present, the option "no programmes implemented because all breeds are secure" was chosen.
Source: Country reports, 2014.

FIGURE 3D2

Breed coverage in conservation activities for the big five species – frequency of responses



Note: 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). The big five species comprise cattle, goats, sheep, pigs and chickens.
Source: Country reports, 2014.

operation for a given breed, the addition of an *ex situ in vivo* programme may not provide much additional benefit in terms of reducing extinction risk (see Part 4 Section D). In all categories, high scores are more common in Latin America and the Caribbean and in Asia than in other developing regions.

Table 3D2 shows that, while in some regions breed coverage within a given category of programme is at a similar level across all species, in other regions 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 3D3, 3D4 and 3D5.

In addition to providing information on the big five species, countries also had the option of providing information on other species. The responses are summarized in Table 3D6. 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 indicating 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 3D2

Breed coverage in conservation activities for the big five species – average scores

Conservation programmes	Species	Africa	Asia	Southwest Pacific	Europe and the Caucasus	Latin America and 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								

0–0.5	0.5–1	1–1.5	1.5–2	2–2.5	2.5–3
Low		Medium		High	

Note: 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).
Source: Country reports, 2014.

3 *In situ* conservation programmes – elements

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 activities 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):

TABLE 3D3

Proportion of countries reporting *in situ* conservation programmes

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 and 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 and the Caucasus	**35**	**78**	**64**	**90**	**97**	**85**	**89**	**77**
Latin America and 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 and 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.
Source: Country reports, 2014.

Activities focused on increasing demand for breed products and services

1. *Promotion of niche marketing or other market differentiation (including promotion via association of breeds with products having geographical indications or other indicators of origin):*[2] 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 or organic) or the association of products with particular geographical regions or traditions.
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.

[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).

TABLE 3D4

Proportion of countries reporting *ex situ in vivo* conservation programmes

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 and 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 and the Caucasus	**35**	**42**	**44**	**48**	**59**	**44**	**50**	**58**
Latin America and 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 and 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.
Source: Country reports, 2014.

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.

Activities focused on incentivizing and supporting 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).

TABLE 3D5

Proportion of countries reporting *ex situ in vitro* conservation programmes

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 and 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 and the Caucasus	**35**	**74**	**58**	**76**	**76**	**56**	**57**	**35**
Latin America and 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 and 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 vitro* 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.
Source: Country reports, 2014.

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.

TABLE 3D6
Level of breed coverage in conservation programmes for "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 fowl	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	

Note: 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).
Source: Country reports, 2014.

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 animal genetic resources (AnGR).
12. *Development of biocultural protocols:* a biocultural protocol is 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 D 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. Moreover, 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, etc. 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 3D7 (species breakdown) and 3D8 (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 3D1 and 3D2 and in Table 3D2 indicate that, at least in developing regions, the majority of reported conservation activities are likely to be being undertaken only on a limited scale.

Globally, the most commonly reported activity is the implementation of conservation breeding programmes (74 percent of responses),[3] followed by the promotion of niche marketing (68 percent), 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 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 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 F).

[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).

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 the 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 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 mentioned in very few of the reports from Africa, the Southwest Pacific and the Near and Middle East.

Use of livestock in the management of wildlife habitats and landscapes is reported to be used as an element of *in situ* 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

TABLE 3D7

Proportion of countries reporting the use of elements of *in situ* conservation – species breakdown

In situ conservation programmes elements		Average across species	Dairy cattle	Beef cattle	Multi-purpose cattle	Sheep	Goats	Pigs	Chickens
Increasing demand for 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 in the management of wildlife habitats and landscapes	24	19	28	30	30	28	22	13
	Promotion of breed-related cultural activities	43	33	43	45	45	49	45	43
Incentivization and support for livestock keepers	Incentives for keeping at-risk breeds	42	39	33	46	47	44	47	37
	Recognition and/or awards for breeders	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 to increase production/productivity	51	42	52	55	57	54	53	44
Community-level participation 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 big five species.
Source: Country reports, 2014.

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 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, note that locally adapted breeds play important roles

TABLE 3D8

Proportion of countries reporting the use of elements of *in situ* conservation – regional breakdown

In situ conservation programmes elements		World	Africa	Asia	Southwest Pacific	Europe and the Caucasus	Latin America and the Caribbean	North America	Near and Middle East
Increasing demand for 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 in the management of wildlife habitats and landscapes	24	4	16	3	49	23	0	7
	Promotion of breed-related cultural activities	43	25	38	19	69	31	14	33
Incentivization and support for livestock keepers	Incentives for keeping at-risk breeds	42	13	35	27	84	13	0	7
	Recognition and/or awards for breeders	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	63	67	83	48	100	31
Breeding programmes	Conservation breeding	74	67	74	32	87	72	43	60
	Selection to increase production/productivity	51	34	53	29	65	54	100	27
Community-level participation 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 big five species comprise cattle, goats, sheep, pigs and chickens.
Source: Country reports, 2014.

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 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.

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 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 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 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. In developed regions, some conservation-related extension activities involve the provision of advice to hobby farmers (see Box 3D3 for example), a group that may be interested in raising at-risk breeds but lack experience in animal husbandry and breeding.

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.

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 raising at-risk breeds. 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 European Union Rural Development Programme to support the conservation of AnGR by providing payments to those keeping at-risk locally adapted 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.

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. 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 suggests 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.

Community-based conservation is more commonly reported in Asia than in any other region (75 percent compared to an average of 48 percent).

Box 3D1

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 appropriate 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, priorities have to be set. 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 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 a 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 conservation 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 lists but not on the national list.

Provided by Hongjie Yang.

As noted above, this activity clearly overlaps with others. Box 3D2 provides an example of the successful involvement of a community in *in situ* conservation activities. Biocultural community protocols (see Box 4D3 in Part 4 Section D) are not widely reported (17 percent overall). Initiatives of this kind are a relatively new phenomenon and relevant only in certain circumstances.

Box 3D2

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 materials used by the women throughout the handicraft production chain, with the aim of improving the quality and utilization of these materials, and thereby to improve the entire production chain and empower the women. Thirty-five 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 practised locally for generations.

Women's associations, in the form of artisan centres, have played a participatory and permanent role in the innovation 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 contributed to improving the women's visibility as 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 *In situ* conservation programmes – the roles of the public and private sectors

In most countries where *in situ* conservation programmes exist, public institutions are directly involved in the implementation of most of the reported activities (Figure 3D3). Involvement of the private sector is more unevenly distributed. In Africa and Asia, public institutions are the main operators of all the *in situ* conservation activities reported, except for the promotion of breed-related niche-market products. In Europe and the Caucasus and Latin America and the Caribbean, involvement of the public and private sectors is reported with roughly equal frequency. In Europe and the Caucasus, private institutions are most commonly involved in the development of niche marketing of breed-related products and in the promotion of breed-related cultural and touristic activities. The involvement of public institutions is prominent in the fields of extension and awareness-raising and in the implementation of conservation breeding programmes.

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

[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.

Box 3D3

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 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, 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.

Photo credit: Kirsti Hassinen.

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 (single nucleotide polymorphism) 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 between some closely related lines.

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

is largely confined to the gene banking of cryoconserved material, while *in situ* conservation is handled largely by breeders' associations. 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 C for a general discussion of stakeholder involvement in breeding programmes). In some European countries (e.g. the Netherlands and the United Kingdom), breeders' associations are reported to be the primary stakeholders in *in situ* conservation, operating with some support from NGOs (see Box 3D3 for example) and government.

Globally, public institutions play a key role in breeding programmes focusing on conservation and/or performance improvement (Figure 3D3).

Box 3D4

Iberian pigs in Spain – sustained through product labelling

As described in a text box in the first report on *The State of the World's Animal Genetic Resources for Food and Agriculture*,[1] 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 eventually led 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.[2]

To address these issues, Spain's Ministry of Agriculture introduced legislation[3] specifically regulating the labelling of all products from Iberian pigs. The aim is to provide consumers with clear information on the characteristics of the products, avoid product fraud and support farmers that produce 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. The labels are differentiated by colour, as follows:

- Black label: products from animals that are pure-bred Iberian and 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 forests.
- 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.

Photo credit: Plácido M. Rodríguez González, AECERIBER-Iberian Pig Breeders' Association of Spain.

[1] FAO, 2007, Box 20 Sustainable utilization of the Iberian pig in Spain – a success story (page 144).

[2] Data from Asociación interprofesional del cerdo ibérico (available in Spanish at http://www.cerdoiberico.es).

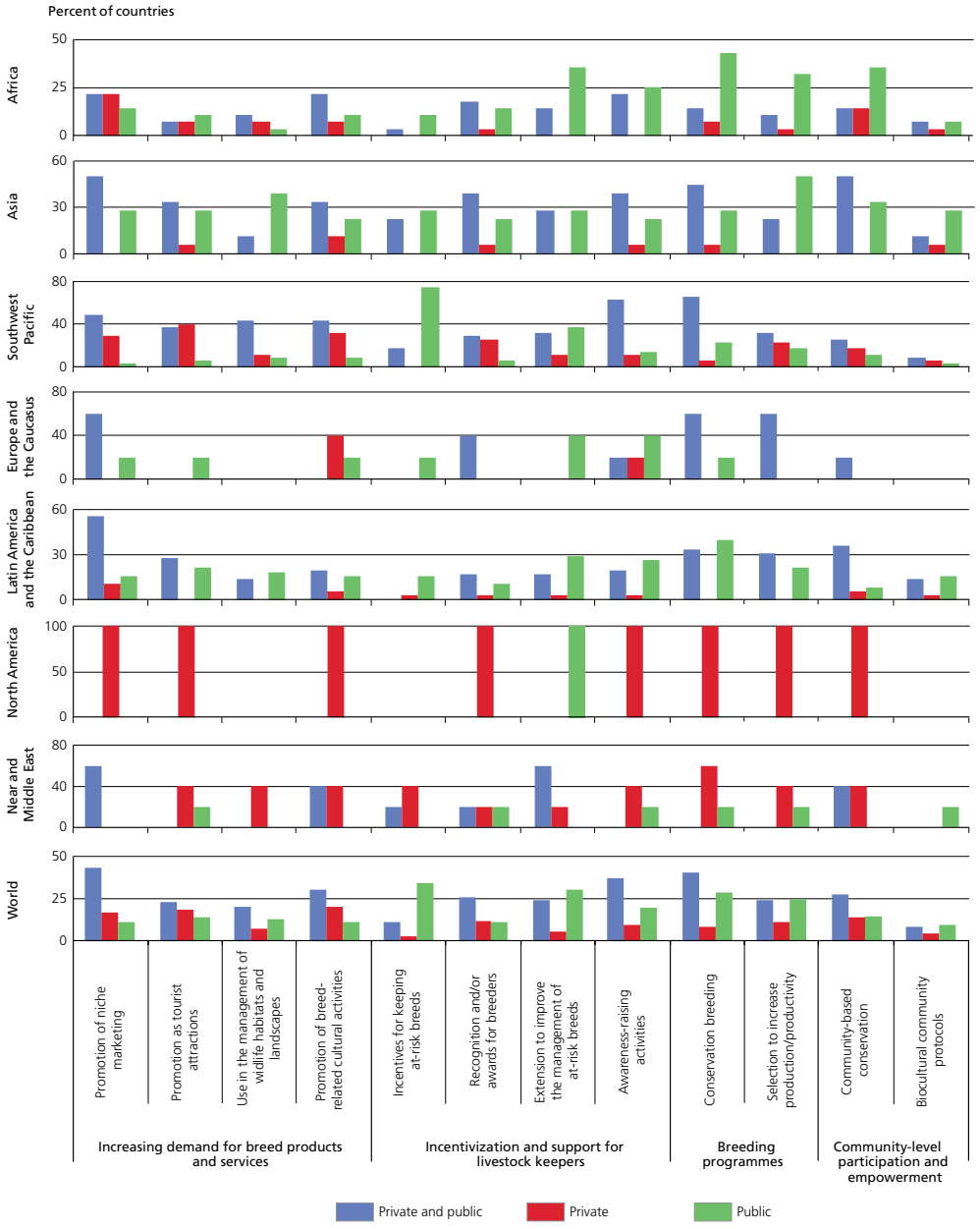
[3] Real Decreto 4/2014, de 10 de enero, por el que se aprueba la norma de calidad para la carne, el jamón, la paleta y la caña de lomo ibérico (available in Spanish at http://www.boe.es/diario_boe/txt.php?id=BOE-A-2014-318).

In the majority of African, Asian and to a lesser extent South American countries, national governments are the main, and usually only, operators of breeding programmes associated with *in situ* conservation. 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 the wider livestock population. Schemes of this kind can play an important role in the conservation and development of at-risk breeds, although their impact is often limited by a range of organizational weaknesses and resource-related constraints (see Part 3 Section C and Part 4 Section C).

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

FIGURE 3D3

Involvement of public and private institutions in the implementation of *in situ* conservation programme elements



Source: Country reports, 2014.

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 also play a key role in extension activities aimed at improving the management of 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.

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 3D4). In addition to being present in the United States of America, gene banks are widely reported 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 report the presence of *ex situ in vitro* conservation programmes (Table 3D1) than report gene banks (Figure 3D4 and Table 3D9). The discrepancy is accounted for mainly by the fact that some countries that do not have gene banks report the storage of cryopreserved genetic material for use in research or breeding programmes or for conservation purposes within the framework of small-scale projects.

Table 3D10 shows the percentage of national breed populations (big five species) reported to be cryoconserved in each region and subregion. The figures show that despite the large number of countries that have established gene banks, only a small proportion of national breed populations are conserved: 27 percent in cattle; 23 percent in sheep; 20 percent in goats; 18 percent in pigs; and 6 percent in chickens. The United States of America is the only reporting 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 substantially lower (in most species fewer than half the cryoconserved breeds have a sufficient quantity of material stored).

Countries 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 3D11. 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 a large number 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 each species. 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 "minor" avian species are almost all very low. Muscovy ducks are something of an exception (material from 43 percent of 21 reported breed populations stored – and in all cases in sufficient quantity to allow the breeds to be reconstituted).

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

TABLE 3D9

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

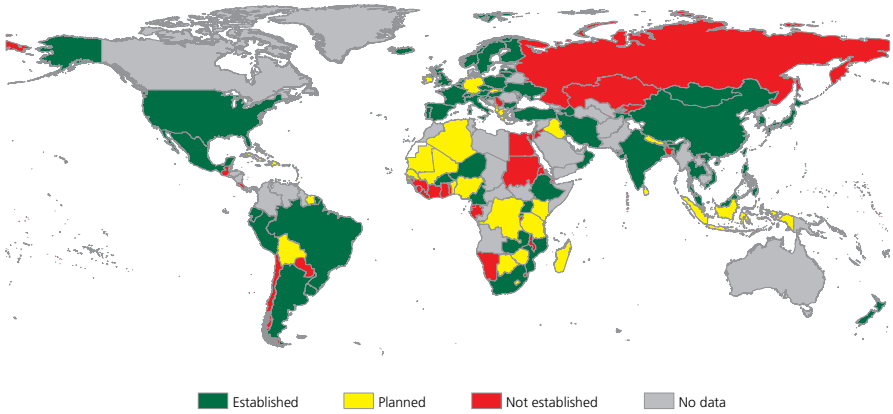
Regions and subregions	Number of countries	Countries reporting gene bank	Proportion of countries storing different types of genetic materials in their gene banks					Countries planning subregional or regional collaboration
			Semen	Embryos	Oocytes	Somatic cells	Isolated DNA	
		%						
Africa	**40**	**23**	**100**	**44**	**11**	**11**	**22**	**33**
East Africa	8	38	100	67	0	0	0	13
North and West Africa	20	15	100	33	33	0	33	40
Southern Africa	12	25	100	33	0	33	33	33
Asia	**20**	**60**	**100**	**67**	**42**	**42**	**67**	**30**
Central Asia	4	50	100	50	50	0	50	25
East Asia	4	100	100	100	50	75	75	0
South Asia	6	33	100	0	0	0	100	17
Southeast Asia	6	67	100	75	50	50	50	67
Southwest Pacific	**7**	**14**	**100**	**100**	**0**	**0**	**0**	**14**
Europe and the Caucasus	**35**	**71**	**100**	**64**	**16**	**48**	**60**	**46**
Latin America and the Caribbean	**18**	**44**	**88**	**75**	**25**	**38**	**38**	**11**
Caribbean	5	40	100	50	0	0	0	20
Central America	5	20	100	100	0	0	0	0
South America	8	63	80	80	40	60	60	13
North America	**1**	**100**	**100**	**100**	**100**	**100**	**100**	**0**
Near and Middle East	**7**	**14**	**100**	**0**	**0**	**0**	**100**	**14**
World	**128**	**45**	**98**	**63**	**23**	**39**	**53**	**30**

Source: Country reports, 2014.

purposes for which the stored material is (or has been) used. Responses are summarized in Tables 3D9 and 3D12. Semen is by far the most commonly stored material, followed by embryos. However, 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 a gene bank 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 responsee).[5] 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 demands (see FAO, 2012).

[5] Responses = country × species combinations.

FIGURE 3D4
State of development of *in vitro* gene banks for animal genetic resources



Source: Country reports, 2014.

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 (FAO, 2012). Only a minority of country reports indicating the presence of a gene bank state that livestock keepers or breeders' associations are involved in its operation.

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 do not provide detailed information on these cases. 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. An example of the reconstitution of a discontinued research line from cryoconserved material is presented in Box 3D5. Only a minority of countries globally (around 30 percent) report that they are involved in international or regional collaboration in gene banking. These cases are discussed in the regional overviews below.

6 Regional overviews

6.1 Africa

In Africa, the main elements of *in situ* conservation are extension activities and breeding programmes focusing on conservation and/or improvement of performance. State farms play a central role. However, there are some differences between the subregions. 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 conservation in this subregion than elsewhere in the region.

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 3D9 and 3D10). However, several country reports mention plans to establish subregional gene banks in Africa. The report from Uganda, for example, mentions the

TABLE 3D10

Breed coverage of the big five species in gene banks

Region and subregions	Reported proportion of national breed populations conserved in 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 and 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**	**10**
Central Asia	Conserved	19	10	14	0	0
	Enough material	12	7	10	0	0
East Asia	Conserved	40	40	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 and the Caucasus	**Conserved**	**40**	**27**	**28**	**27**	**5**
	Enough material	**23**	**10**	**12**	**12**	**3**
Latin America and the Caribbean	**Conserved**	**15**	**15**	**15**	**5**	**0**
	Enough material	**12**	**10**	**7**	**5**	**0**
Caribbean	Conserved	20	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 and 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.
Source: Country reports, 2014.

TABLE 3D11
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	1 317	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 fowl	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.
Source: Country reports, 2014.

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 the Subhumid Zone, based in Burkina Faso. The report from South Africa mentions the intention to collaborate with other Southern African Development Community countries (Botswana, Mozambique, Namibia, Zambia and Zimbabwe).

6.2 Asia

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 widespread *in situ* conservation activities in this subregion are awareness raising, conservation breeding programmes, promotion of niche market products and community-based conservation. In South and Southeast Asia, a lot of attention is paid to awareness-raising

TABLE 3D12
Characteristics and functions of national gene banks

Regions and subregions	Number of countries	Storage of not-at-risk breeds	Participation of livestock keepers/ breeders' association	Increasing genetic variability in *ex situ* populations	Increasing genetic variability in *in situ* populations	Reconstitution of extinct breeds
		%				
Africa	**9**	**35**	**30**	**31**	**33**	**4**
East Africa	3	17	17	11	17	0
North and 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 and the Caucasus	**25**	**58**	**61**	**10**	**24**	**1**
Latin America and 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 and 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 banks. 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).

activities. For example, the country reports from Indonesia and the Philippines mention the use of the internet and social media in addition to traditional means of promoting locally adapted breeds. Some attention is also given to the establishment of breeding programmes for at-risk breeds. The country report from India, for example, mentions several 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 3D9). In general, the gene banks in East and Southeast Asia are more developed than those in the other two subregions. In every major species, the gene banks of East and Southeast Asia store material from a higher proportion of reported breed populations than those in Central and South Asia (Table 3D10).

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

Box 3D5
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, both of 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 then re-established using the cryopreserved material.

Source: Reproduced from FAO, 2012.

banks in China and Japan. Although gene banks are relatively uncommon in the reporting countries of 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, buffaloes, horses and asses. Cattle genetic material from the gene bank has been used to increase the genetic variability and population sizes of cattle breeds such as the Tharparkar, Sahiwal, Krishna Valley and Hariana. In Southeast Asia, Malaysia, the Philippines, Thailand and Viet Nam all report the presence of a gene bank, 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.

6.3 Europe and the Caucasus

In Europe and the Caucasus, *in situ* conservation programmes are well developed and generally involve a range of different elements (supplementary tables A3D1 to A3D7).[6] 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 operating in the European Union for protected designations of origin.

The majority of the countries in the region report well-established gene banks. However, the breed coverage of *ex situ in vitro* programmes remains far from complete: material from 40 percent of the

[6] Supplementary tables for Part 3 are provided on CD ROM and at http://www.fao.org/3/a-i4787e/i4787e197.pdf

Box 3D6

Conservation of the Gembrong goat of Bali (Indonesia): a breed brought close to extinction by nylon fishing line

Gembrong means "lots of hair" in Balinese. The Gembrong goat's long shiny white hair was the basis for one of the breed's traditional uses: the hair was used as a lure for fishing. The introduction of nylon line in the fishing industry reduced the profitability of raising Gembrong goats and the breed's population experienced a severe decline. Today (May 2014) only 56 animals remain. The Ministry of Agriculture, the Indonesia Institute of Science, local government and universities are giving serious attention to the task of saving the breed. A conservation programme has been set up, including both *in situ* and *ex situ* components. A budget was allocated to support feeding and shed repair for the main *in situ* population, which consists of 26 animals kept by one farmer at the eastern tip of Bali province. There is another small four-animal herd in East Java. A conservation breeding programme is being implemented, and currently six bucks have been selected for breeding to minimize inbreeding in the *in situ* population. The *ex situ* conservation component of the programme consist of an *in vitro* collection, with a target of 200 straws of frozen semen for 2014, kept at the Indonesia Agency for Agriculture Research and Development. In addition, two *ex situ* herds have been created: one 19-animal herd at the Goat Research Institute in North Sumatra and one small herd of 7 animals in the Taman Ujung National Park. The next step being considered is a cross-breeding/back-crossing programme to increase the population size while controlling inbreeding. The plan is to inseminate females of the Kacang breed with semen from Gembrong bucks, with the aim of generating, in five to ten years, an almost pure herd of Gembrong goats. However, the cost of the implementing this plan has been estimated to be almost US$400 000 in total, and its economic viability is under discussion.

Photo credit: I Made Londra.

Provided by Bess Tiesnamurti, Aron Batubara and I Made Londra.

reported cattle breed populations and less than 30 percent of reported sheep, goat and pig breed populations is stored in gene banks. Chickens are even less well represented, with material from only 5 percent of the reported breed populations included in gene banks (Table 3D10).

Two types of gene bank 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 or 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 3D7. Despite the generally

Box 3D7

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 in 2007, 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 collection. The organization administrates the doses using the CryoWEB software.[1] 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.

[1] http://cryoweb.tzv.fal.de/

well-developed state of *ex situ in vitro* conservation in this region, several countries have no gene banks and have no plans to establish them (Figure 3D4). A network of gene banks involving 23 countries is being developed (Box 3D8).

6.4 Latin America and the Caribbean

In situ conservation programmes in Latin America and the Caribbean involve both government and private initiatives. The main elements of programmes in this region are breeding schemes focusing on conservation and/or performance improvement (in which governmental nucleus farms play a key role), promotion of niche-market products and awareness-raising activities. However, there is great diversity within the region in terms of the types of conservation activities undertaken (supplementary tables A3D1 to A3D7)[7] and in the levels of breed coverage (Figure 3D1). 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

[7] Supplementary tables for Part 3 are provided on CD ROM and at http://www.fao.org/3/a-i4787e/i4787e197.pdf

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 ongoing breeding programmes and for long-term conservation. Gene banks are common in South America, but scarce in Central America and the Caribbean. *Ex situ in vivo* conservation is relatively well-developed in the region.

6.5 Southwest Pacific

In the small island countries of the Southwest Pacific, *in situ* conservation programmes, if they exist at all, are in their early stages of development and focus mainly on pigs and chickens (Tables 3D2 and 3D3). 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[8] 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.

Gene banks are present only in Australia and New Zealand. In both countries, the banks are operated by private bodies rather than by the public sector. In New Zealand, the Rare Breeds Conservation Society of New Zealand, in collaboration with a private cryostorage facility, maintains a genetic repository 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. 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 society organizations support *ex situ* conservation. *In vitro* programmes in Australia only include at-risk breeds with commercial potential. There are no gene banks in the small island countries of the region.

6.6 North America

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, 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 3D10). The primary role of the programme is to serve as a backup of *in situ* livestock populations that can be drawn upon if 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.

6.7 Near and Middle East

In the Near and Middle East, *in situ* conservation programmes are generally in their early stages of development. Oman has a well-developed strategic plan for the conservation of dromedary, cattle, sheep, goat and chicken genetic resources. Initial efforts are focusing 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

[8] 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.

Box 3D8

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.[1] The main tasks of this Working Group are to:

1. exchange experiences and knowledge among European countries;
2. support the establishment, development, efficiency and effectiveness of European national gene banks; and
3. jointly develop a European strategy for gene banking, documentation and other related issues.

In 2013, the first steps were taken, under the umbrella of the ERFP, to officially establish the European Gene Bank 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. A regional approach could help to further develop and enhance the quality standards of national gene banks. A regional portal or documentation system could 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;
- 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 for 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.

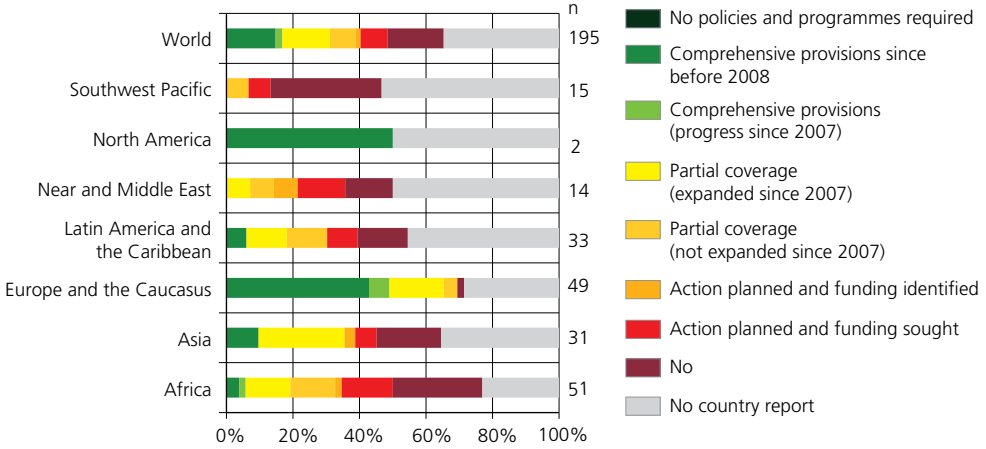
[1] http://www.rfp-europe.org/index.php?id=597

international agreements promoting 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 locally adapted breeds. Oman is also the only country in the region that reports a gene bank (semen and isolated DNA of two multipurpose cattle breeds are stored and are used for both conservation and breeding purposes).

7 Changes since 2007

Because of difference between the samples of reporting countries, it is difficult to present a direct comparison of the state of capacity in 2014 to that 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 3D5 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. It appears that some countries interpreted this question more

FIGURE 3D5
State of conservation programmes and policies at country level and progress since 2007



Note: Countries were asked the following question: Does your country have conservation policies and programmes in place to protect locally adapted breeds at risk in all important livestock species? Response options were as follows: a. Country requires no policies and programmes because all locally adapted breeds are secure; b. Yes, comprehensive policies and programmes have been in place since before the adoption of the GPA; c. Yes, comprehensive policies and programmes exist because of progress made since the adoption of the GPA; d. For some species and breeds (coverage expanded since the adoption of the GPA); e. For some species and breeds (coverage not expanded since the adoption of the GPA); f. No, but action is planned and funding identified; g. No, but action is planned and funding is sought; h. No.
GPA = Global Plan of Action for Animal Genetic Resources; n = number of countries.
Source: Country reports, 2014.

strictly than the question about the presence of the various categories of conservation activity (Table 3D1). A possible explanation for the discrepancy is that some countries have some conservation measures in place but that these do not form part of an organized policy or programme.

According to the country reports, the main obstacle to the improvement of conservation measures is a lack of financial resources. Other frequently mentioned obstacles include a lack of skilled personnel, a lack of technical capacity, a lack of adequate information on AnGR, a lack of national policies and legal frameworks, and insufficient coordination among stakeholders.

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 (see Box 3D3 for example). 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, 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 capacities and institutional structures needed for effective AnGR management (see Part 3 Section A for further discussion). In some countries, however, the prerequisites for successful conservation programmes are largely in place and the main challenge is to strengthen the political will to act.

The breed coverage of *ex situ in vitro* conservation programmes is still very limited overall, and many countries have no gene banks. Many report that they have plans to establish gene banks, but lack of funding and lack of technical skills often remain significant constraints. 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 regions and subregions. Country-report responses related to the organization and operation of gene banks suggest that in many cases more could be done with regard to 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 stakeholders in the development and operation of gene banks is another area that may need strengthening.

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