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COMMISSION ON GENETIC RESOURCES
FOR FOOD AND AGRICULTURE

THREATS TO ANIMAL GENETIC RESOURCES –
THEIR RELEVANCE, IMPORTANCE AND OPPORTUNITIES
TO DECREASE THEIR IMPACT

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1.   INTRODUCTION

The *Global Plan of Action for Animal Genetic Resources* (GPA) (FAO, 2007a) is the first internationally agreed framework for the management of animal genetic resources for food and agriculture (AnGR); it aims to promote the utilization of AnGR without compromising genetic diversity. The GPA stipulates 23 strategic priorities for action which if implemented could help achieve Millennium Development Goals One (eradicate extreme hunger and poverty) and Seven (ensure environmental sustainability). Identifying threats facing AnGR and their dynamics is a step towards the implementation of the GPA, contributing particularly to Strategic Priority Area 1: Characterization, Inventory and Monitoring of Trends and Associated Risks; Strategic Priority Area 3: Conservation; and Strategic Priority Area 4: Policies, Institutions and Capacity-building.

The Intergovernmental Technical Working Group on Animal Genetics Resources for Food and Agriculture, at its Fifth Session, recommended that the Commission on Genetic Resources for Food and Agriculture request countries to investigate and report on the underlying causes of the erosion of AnGR diversity.[1] This background study paper aims to provide understanding of threats to AnGR, along with potential areas of intervention. Major threats faced by breeds of important livestock species and their dynamics are identified and described.[2]

2.   CURRENT STATUS OF ANIMAL GENETIC DIVERSITY

Tremendous genetic variation arising from natural selection for adaptation to different environments and from artificial selection for different breeding objectives is found in the world's livestock. This variation is essential for meeting human requirements for food and agriculture in a sustainable way. It guarantees the flexibility needed to adapt to changing breeding objectives. Livestock genetic diversity is at risk from several threats. There is broad agreement in the literature regarding the general trends and factors threatening AnGR. For example, Rege and Gibson (2003) identify the use of exotic germplasm, changes in production systems, changes in producer preference because of socio-economic factors, and a range of disasters (drought, famine, disease epidemics, civil strife/war) as the major causes of genetic erosion. Tisdell (2003) mentions development interventions, specialization (emphasis on a single productive trait), genetic introgression, the development of technology and biotechnology, political instability and natural disasters. FAO (2007b) describes threats related to livestock-sector trends driven by economic, social and policy factors; disasters and emergencies; and disease and disease-control strategies. At an international workshop held in 2005 (Gibson *et al.*, 2006) a consensus among participants was that AnGR are increasingly under threat and that the situation will worsen in the future.

The Global Databank for Animal Genetic Resources currently (September 2009) contains data from 181 countries and 37 species with 7 998 reported breeds; 6 947 are local breeds (each reported by only one country) and 1 051 are transboundary breeds (each reported by several countries). In Europe and the Caucasus, Asia, and the Near and Middle East, local breeds make up about three-quarters of all breeds. In Africa, and Latin America and the Caribbean, the share of local breeds is smaller, but still exceeds 60 percent. Conversely, international transboundary avian and mammalian breeds dominate in the Southwest Pacific and North America. Africa has a large share of regional transboundary breeds of cattle, goats and asses. Europe and the Caucasus, however, has by far the highest number of regional transboundary breeds among

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[1] CGRFA/WG-AnGR-5/09/REPORT, paragraph 21.

[2] This document has been prepared by the Agriculture and Consumer Protection Department of FAO (in particular Irene Hoffmann, Beate Scherf, Mateusz Wieczorek and Dafydd Pilling of the Animal Production Service, and Joram Mwacharo)

avian species. The existence of significant numbers of regional transboundary breeds has implications for management and conservation of AnGR, and highlights the need for cooperation at regional or subregional levels (FAO, 2007b).

For 34 percent of all mammalian breeds no population census data are available. The problem is particularly significant in some species (e.g. 58 percent of both ass and dromedary breeds). In Latin America and the Caribbean 68 percent and 84 percent of mammalian and avian breeds, respectively, are classified as being of unknown risk status; the figures for the Southwest Pacific region are 76 percent for mammalian species and 68 percent for avian species; and for Africa 59 percent for mammalian species and 60 percent for avian species. This lack of data is a serious constraint to effective prioritization and planning of breed conservation measures.

A total of 1619 breeds (20 percent) are classified as being at risk. The proportion of breeds classified as at risk is lower for mammalian species (17 percent) than for avian species (31 percent). However, in absolute terms, the number of breeds at risk is higher for mammalian species (952 breeds) than for avian species (667 breeds). Rabbits are the mammalian species with the highest proportions of breeds at risk (36 percent), followed by horses (20 percent), pigs (17 percent) and cattle (16 percent).

The regions with the highest proportion of their breeds classified as at risk are Europe and the Caucasus (29 percent of mammalian breeds and 50 percent of avian breeds) and North America (19 percent of mammalian breeds and 81 percent of avian breeds). Europe and the Caucasus, and North America are the regions that have the most highly specialized livestock industries, in which production is dominated by a small number of breeds. In absolute terms, Europe and the Caucasus has by far the highest number of at-risk breeds. Despite the apparent dominance of these two regions, problems in other regions may be obscured by the large number of breeds with unknown risk status.

A total of 695 reported breeds are already extinct. Rapid changes in the livestock sector have heightened the need to address the decline in AnGR diversity. The changes are driven by increased demand for livestock products (Delgado *et al.*, 2002) due to increasing human population, urbanization and rising incomes (United Nations, Department of Economic and Social Affairs, Population Division, 2009). Cattle are the species with the highest number of breeds (196) reported as extinct. Large numbers of extinct pig, sheep and horse breeds are also reported. There is, however, clearly a possibility that there were breeds that became extinct before they were documented, and which are therefore missing from the analysis. Among avian species, chickens have by far the highest number of breeds at risk on a world scale. In the majority of avian species more than 24 percent of breeds are classified as at risk (guinea fowl and partridge – both of which have few breeds in total – are the only exceptions). In the case of chickens, geese, turkeys, quail, pigeons and ostrich, the proportion is close to one-third. As in the case of mammalian species, there are a large number of breeds (42 percent) for which population figures are unavailable. Extinct breeds have mainly been reported among chickens; there are also a few cases among ducks, guinea fowl and turkeys.

Analyses of the specific threats affecting particular livestock breeds, and of the reasons for past breed extinctions are quite rare. Drivers of past and current breed extinctions are not documented in the Domestic Animal Diversity Information System (DAD-IS)[3] and only limited information on these drivers is available in the Domestic Animal Genetic Resources Information System (DAGRIS)[4] hosted by the International Livestock Research Institute. Where such drivers are documented in the literature, the analysis is limited in geographic scope and to particular species or breeds. For at-risk cattle breeds in Africa, Rege (1999) lists replacement by other breeds, cross-breeding with exotic breeds or with other indigenous breeds, conflict, loss of

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[3] www.fao.org/dad-is.

[4] http://dagris.ilri.cgiar.org.

habitat, disease, neglect and lack of sustained breeding programmes among the threats. Similarly, Iñiguez (2005) identifies displacement by other breeds, and indiscriminate cross-breeding as threats to small ruminant breeds in West Asia and North Africa. Carson *et al.* (2009) demonstrate that endemism (restriction to a limited geographical area) is a serious threat to several native sheep breeds in the United Kingdom. A systematic analysis of threats to reveal global and regional trends is, however, still lacking. The dynamics of threats affecting particular breeds and species are also yet to be determined.

3.   SCOPE, OBJECTIVES AND METHODS

The objectives of this study are to analyse, describe and evaluate threats facing livestock breeds and to identify potential areas of intervention. The results reported here are derived from three independent but related studies. An exploratory questionnaire survey was carried out in 2005 and a more detailed one in 2009. Both questionnaires were distributed via the Domestic Animal Diversity Network (DAD-Net[5]), which currently has close to 1500 subscribers, in order to ensure the widest coverage in the shortest time possible. The third study was based on a query executed in DAD-IS and DAGRIS to obtain a list of breeds that are classified as at risk or extinct. National Coordinators for the Management of AnGR were then requested to provide information on the factors contributing to the risk statuses of these breeds. The 2005 exploratory questionnaire was used to reveal the general dynamics of threats irrespective of the livestock species and geographic region. It aimed to shed more light on the nature of threats that had been identified by an expert group (Gibson *et al.*, 2006). It was answered by 204 persons from 82 countries, providing 858 threats. The questionnaire and respondent profile are provided in Annex 1. This paper focuses largely on the results of the 2009 survey because it was the more comprehensive of the two.

The 2009 questionnaire was based on a list of five broad categories of threats with 12 subcategories (see Annex 2.1) which was compiled from the literature (see bibliography) and the results of the 2005 questionnaire. The questionnaire allowed respondents to express their opinions concerning threats to AnGR in various agro-ecological zones (AEZ) and livestock production systems (LPS) in their countries, subregions or regions. Countries were classified according to their income level following the World Bank classification[6] and according to the FAO regions (as used in DAD-IS). AEZ and LPS were defined following FAO (1996a) and FAO/WAAP (2008). The responses were used to identify threats to AnGR on a global scale and in different geographic regions. In the questionnaire, respondents were also asked to identify up to three threatened breeds of poultry (chicken, duck, turkey); large ruminants (cattle, buffaloes); small ruminants (sheep, goats); equines (ass, horse); pigs and camelidae (Bactrian camel/dromedary/llama/alpaca/guanaco/vicuña) and then, based on their opinions and experiences, to list the three most important threats facing each of these breeds. For each threat and breed, respondents were also asked to state the trend (increasing, constant, decreasing), the proportion of the population likely to be lost (<25 percent, 25–50 percent, 50–75 percent, >75 percent), the spatial scale on which the threat acts (local, national, subregional, regional, global) the frequency of occurrence (emerging, continuous, seasonal, recurring, rare) and the timescale over which the effects of threats on the breeds are likely to be seen(< 1 year, 1–5 years, 5–10 years, > 10 years). The questionnaire is provided in Annex 2.2. It was answered by 107 persons from 55 countries, who provided information on the threats affecting 450 breeds – 1305 threats in total. The profile of the respondents and the distribution of responses are provided in Annexes 2.3 and 2.4, respectively.

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[5] DAD-Net (Domestic Animal Diversity Network) is run by the Animal Genetic Resources Group of FAO and provides an informal forum to discuss issues relevant to the management of AnGR (DAD-Net@fao.org).

[6] http://go.worldbank.org/K2CKM78CC0.

Based on information extracted from FAO's Global Data Bank on AnGR (the backbone of DAD-IS) and DAGRIS, country-wise lists of breeds that are currently classified as at risk or that have been reported to be extinct were prepared and sent to the National Coordinators for the Management of AnGR in the respective countries. The National Coordinators were requested, using the list of threats compiled *a priori* and in consultation with their peers, to identify the threats facing the breeds listed for their country or at least to provide reasonable guesses; in the case of extinct breeds they were asked to provide information on the reasons for the extinction. National Coordinators added breeds to the file and changed risk statuses which complicated the analysis (and emphasizes the need for National Coordinators to carefully check, edit and update their national information in DAD-IS). Respondents were able to list as many different threats as they wished. However, for the purposes of the analysis the first seven listed threats in six species groups poultry (chicken, duck, goose, turkey, guinea fowl, Muscovy duck, ostrich, partridge, pigeon, quail); large ruminants (cattle, buffalo); small ruminants (sheep, goat); equines (ass, horse); pigs and rabbits were used.

Some questions in the questionnaires allowed for several replies and respondents were not obliged to answer all questions. Therefore, the number of valid cases (n) varied. The data were analysed using descriptive statistics (frequency). The results from the different sources of information were combined to provide an overall view of threats affecting breed diversity.

Preliminary findings from this study were discussed during a three week-long moderated electronic conference hosted on DAD-Net. The theme of the conference was "Analysing threats to domestic animal genetic resources". During the electronic conference, contributors were encouraged to air their views openly. In total, 21 persons took part in the electronic conference (4 from Africa, 9 from Asia, 2 from the Near East, 1 from Europe, none from North America, and 3 from Latin America and the Caribbean, and 2 from international organizations).

4.   RESULTS AND DISCUSSION

4.1.   Overview of threats to animal genetic resources – questionnaire results

The majority of respondents to the questionnaires were from universities and research (53 percent in 2005, 61 percent in 2009), followed by ministries and other government agencies (16 percent in 2005, 36 percent in 2009). They were mostly male (75 percent in 2005) and well educated (55 percent with PhD in 2005). The questionnaires were completed by respondents from all geographic regions and a wide range of countries (37 countries in 2005, 55 in 2009).

For the purposes of analysing the data from 2009, the threats were classified according to the following 12 categories:

- economic and market drivers;
- poor livestock sector policies;
- socio-political instability;
- lack of functional institutions;
- poor conservation strategies;
- disease and disease control;
- loss of labour force;
- loss of production environment;
- replacement of breed functions;
- climate change;
- natural disasters; and
- use of reproductive technologies.

The three threats that were mentioned by most respondents and hence can be regarded as the most significant in eroding AnGR diversity across all species were:

1.   economic and market drivers (28.5 percent)

2.   poor livestock sector policies (20.2 percent)

3.   poor conservation strategies (14.5 percent).

The following were mentioned by 5–10 percent of respondent:

- socio-political instability (9.3 percent);
- lack of functional institutions (6.8 percent);
- disease and disease control (6.4 percent); and
- loss of labour force (6.0 percent).

The remaining threats were mentioned by less than 5 percent of respondents and seem to be less significant:
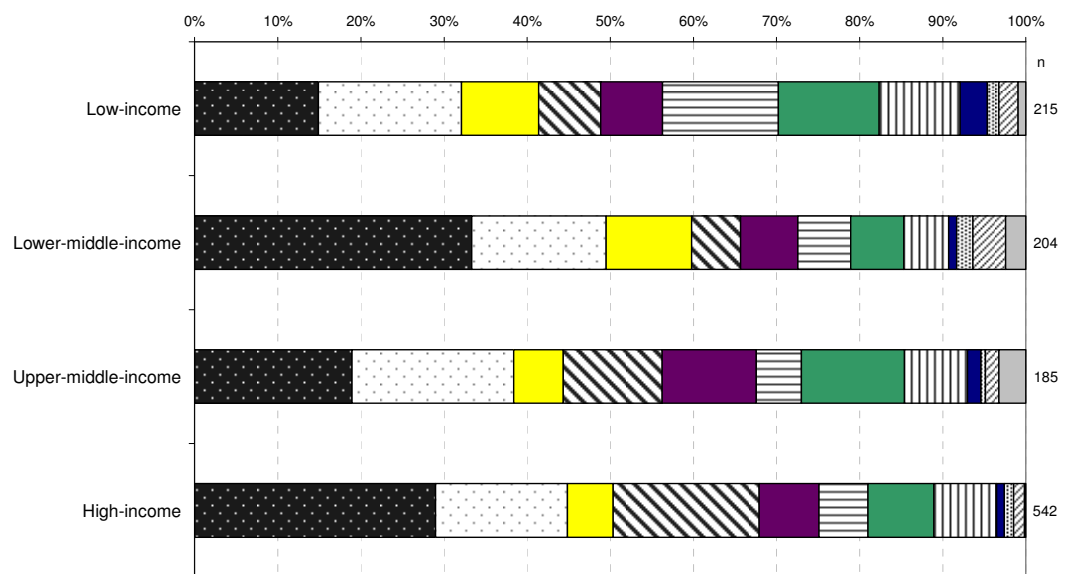
- loss of production environment (4.3 percent);
- replacement of breed functions (2.2 percent);
- climate change (1.0 percent);
- use of reproductive technologies;
- (0.5 percent); and
- natural disasters (0.4 percent).

> Mamadou Sangare (Burkina Faso) pointed out that local woollen clothes that were in demand until a decade ago, have of late been less in demand because of increasing competition from synthetic and cotton clothes. This has put the local Macina wool sheep under threat. The same applies to Somba, Ndama and other small-sized cattle breeds when compared to Zebu cattle which are more highly valued because of their larger body sizes and stronger ploughing ability.

Source: DAD-Net e-conference, May 2009.

The priority threats differed slightly according to the level of economic development of the country (Figure 1). For example, economic and market drivers were slightly more prominent among the responses from lower-middle-income countries (33 percent of all responses for this group) than high-income countries (29 percent); the lowest figure was for low-income countries (15 percent). This may be because of slower structural change in the low-income countries. The fact that responses mentioning lack of functional institutions were more prominent in high-income countries (15 percent) than elsewhere probably reflects a higher level of awareness and expectation in these countries.

**Figure 1.** Global distribution of responses for threats, by economic development level of the country

Source: 2009 questionnaire (1146 threats).

■ Economic and market drivers
☐ Poor livestock sector policies
☐ Socio-political instability
◣ Lack of functional institutions
■ Poor conservation strategies
☰ Disease and disease control
■ Loss of labour force
▥ Loss of production environment
■ Replacement of breed functions
▦ Climate change
▨ Natural disasters
☐ Use of reproductive technologies

The ranking of threats also tended to differ across geographic regions (Figure 2). For example, in Asia, poor livestock sector policies (36 percent) rather than economic and market-driven threats (25 percent) were mentioned by the highest number of respondents. Some threats were not mentioned at all in particular regions. For example: climate change, natural disasters and replacement of breed functions were not mentioned by any respondents from Asia and the Pacific, North America or the Near East; loss of labour force was not mentioned by any respondents from Asia and the Pacific or the Near East; modern reproductive biotechnologies (artificial insemination, multiple ovulation and embryo transfer, etc) were not regarded as threats in Asia and the Pacific, or North America. It is, however, not safe to conclude that these threats are insignificant in the respective regions. Regional differences (see Annex 2.4 for details of the uneven distribution of responses by region) probably to some extent reflect different expectations and levels of awareness – the above-mentioned prominence given to lack of functional institutions among respondents from in developed countries is reflected in the results from Europe and North America. Apparent similarities among regions should also be interpreted carefully; for example, socio-political instability is mentioned across all regions but responses probably refer to a wide spectrum of different types of instability, ranging from changes in government policy to civil strife and war.

Figure 2. Global distribution of responses for threats, by geographical region
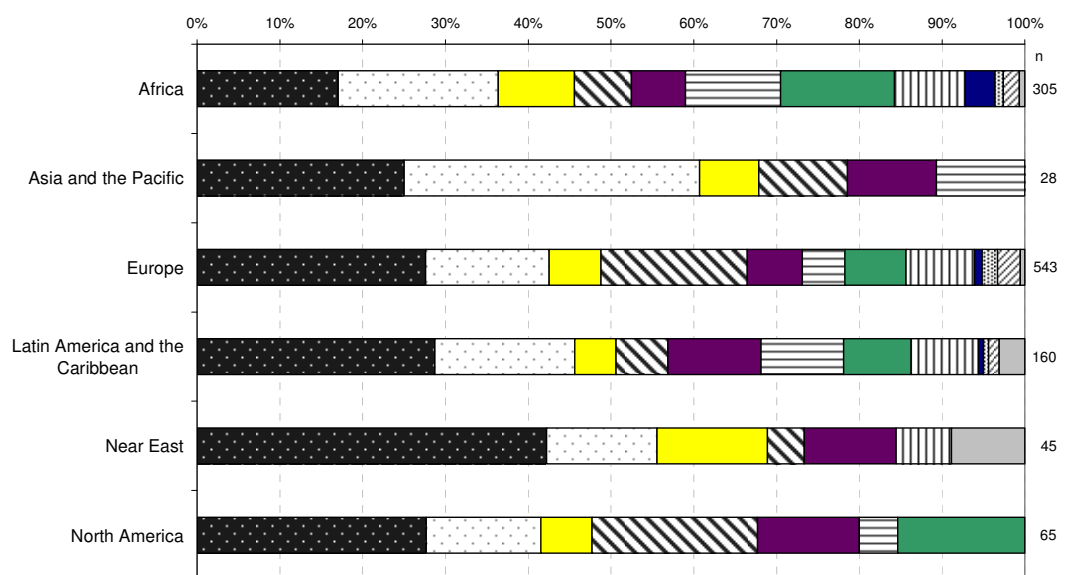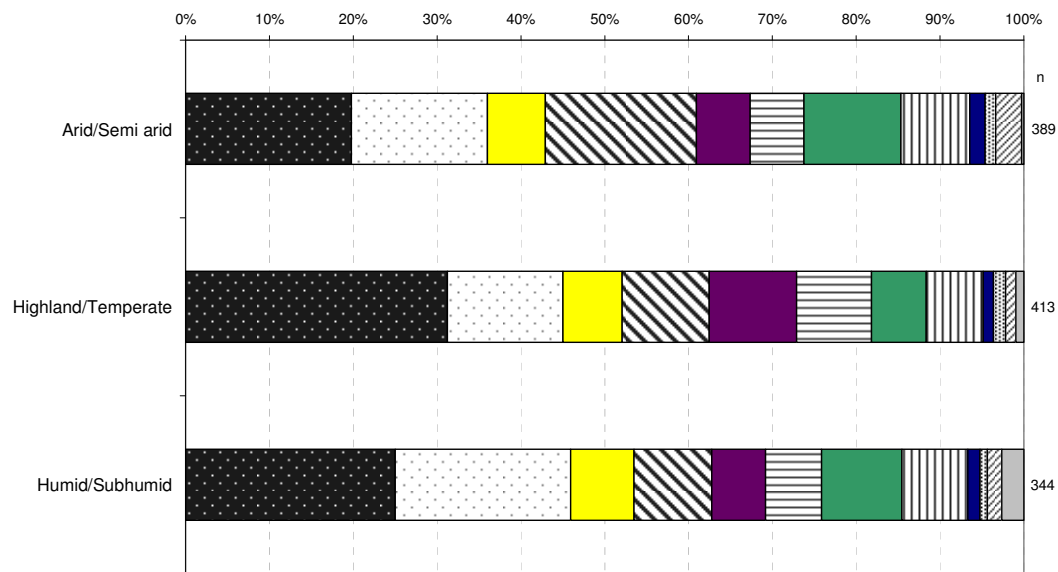

Source: 2009 questionnaire (1146 threats).

Legend:
- Economic and market drivers
- Poor livestock sector policies
- Socio-political instability
- Lack of functional institutions
- Poor conservation strategies
- Disease and disease control
- Loss of labour force
- Loss of production environment
- Replacement of breed functions
- Climate change
- Natural disasters
- Use of reproductive technologies

Some threats differed by AEZ and LPS. Economic and market drivers were mentioned more frequently as threats affecting highland/temperate (31 percent) and humid/sub-humid zones (25 percent) than arid/semi-arid zones (20 percent). Lack of functioning institutions was more frequently mentioned for arid/semi-arid zones (18 percent) (Figure 3). A detailed breakdown of responses by LPS and AEZ is provided in Annex 2.5.

Maria da Gloria Taela (Mozambique) and Nichol Nonga (Secretariat of the Pacific Community) confirmed that the threats identified in the e-conference background document were prevalent in their countries and regions, but the degree of threat varied. Maria da Gloria Taela gave particular attention to threats related to policy development and institutional capacity. She gave an example of uncontrolled cross-breeding aimed at improving production as a source of genetic erosion in local breeds. She stated that her country lacks a national AnGR conservation and improvement policy while the National Insemination Centre was under-funded and has had to reduce the number of semen straws in stock..

Source: DAD-Net e-conference, May 2009.

Figure 3. Global distribution of responses for threats, by agro-ecological zone

Source: 2009 questionnaire (1066 threats).

- Economic and market drivers
- Poor livestock sector policies
- Socio-political instability
- Lack of functional institutions
- Poor conservation strategies
- Disease and disease control
- Loss of labour force
- Loss of production environment
- Replacement of breed functions
- Climate change
- Natural disasters
- Use of reproductive technologies

Livestock production systems are changing. Recent times have seen the conversion of grazing grounds into cropland. This has implications for the sustainability of livestock production systems and for human livelihoods that depend on livestock. Increased demand for livestock products has led to the intensification of production systems and to increased productivity. The quest to improve production has resulted in the livestock sector becoming increasingly dominated by a few high-producing breeds. This has narrowed the gene pool.

The more a LPS depends on the market, the more frequently economic and market drivers were mentioned as threats: from 45 percent in industrial systems to 20–30 percent in mixed crop/forest/livestock systems, to less than 15 percent in pastoral and backyard systems (Figure 4).

Figure 4. Global distribution of responses for threats, by livestock production systems
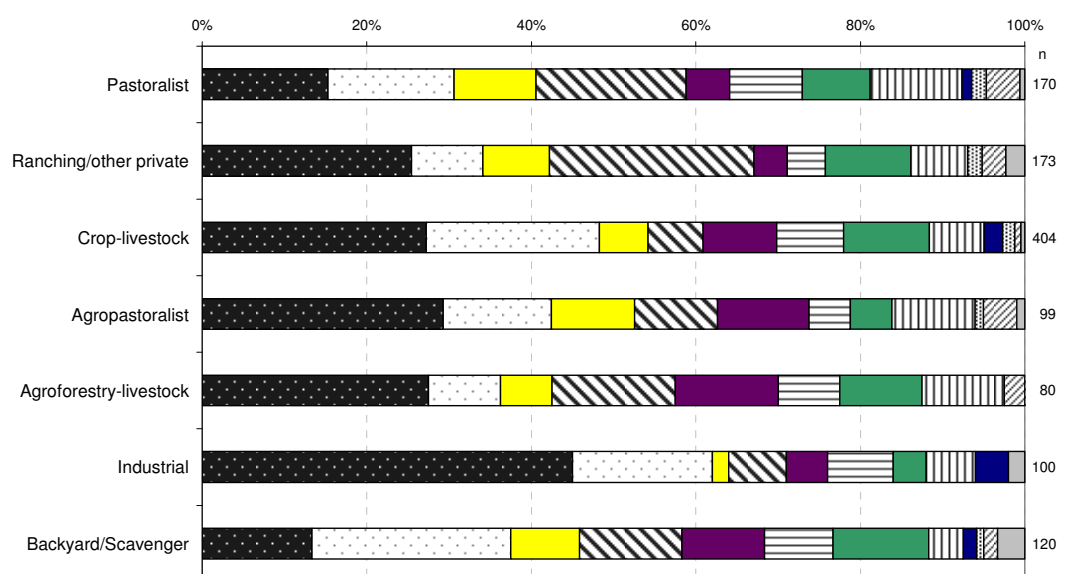
Source: 2009 questionnaire (1066 threats).

- ■ Economic and market drivers
- □ Poor livestock sector policies
- ■ Socio-political instability
- ◩ Lack of functional institutions
- ■ Poor conservation strategies
- ▤ Disease and disease control
- ■ Loss of labour force
- ◫ Loss of production environment
- ■ Replacement of breed functions
- ▨ Climate change
- ▨ Natural disasters
- ▨ Use of reproductive technologies

Poor livestock sector policies were the most frequently mentioned threat in backyard/scavenging systems (24 percent), which are known to be often neglected by policies and extension, and also in crop-livestock systems (21 percent). Many respondents considered that lack of functioning institutions is an important threat in grassland-based systems (25 percent of responses for ranching/other private grassland systems, 18 percent for pastoral systems).

Some threats were not regarded by any respondent to be a cause of concern for AnGR in certain production systems. For example, replacement of breed functions was not considered a threat in agroforestry–livestock systems, agropastoralist systems or ranching/other private grazing systems; the use of modern reproductive biotechnologies and climate change was not considered a threat in agroforestry–livestock systems. Climate change and natural disasters were not considered threats in industrial systems, which are usually well protected against environmental adversities.

Salah Galal (Egypt) did not agree with the observation that there are no threats to AnGR that are specific to particular agro-ecological zones and livestock production systems. Similar sentiments were expressed by Maria da Gloria Taela (Mozambique), Sassamma Iype (India), Mamadou Sangare (Burkina Faso) and William Vivanco (Peru). A consensus among the respondents was that the intensification of livestock production and indiscriminate cross-breeding threatens local AnGR in specific agro-ecological zones and production systems. They all gave concrete examples from their respective countries and regions to emphasize their points.

Source: DAD-Net e-conference, May 2009.

The responses suggest that, as a general trend, threats caused by economic and market drivers become an increasing problem as market orientation shifts from local to international markets (Figure 5). This is also the case for the shift from subsistence to full commercial orientation (Figure 6), with the exception of commercially oriented farms in arid/semiarid systems where lack of functioning institutions plays a bigger role than market forces. Loss of labour force seems less of a threat in fully commercial than in more subsistence-oriented systems. A detailed breakdown of threats by market orientation within AEZ can be found in Annex 2.6.

Figure 5. Global distribution of responses for threats, by market orientation
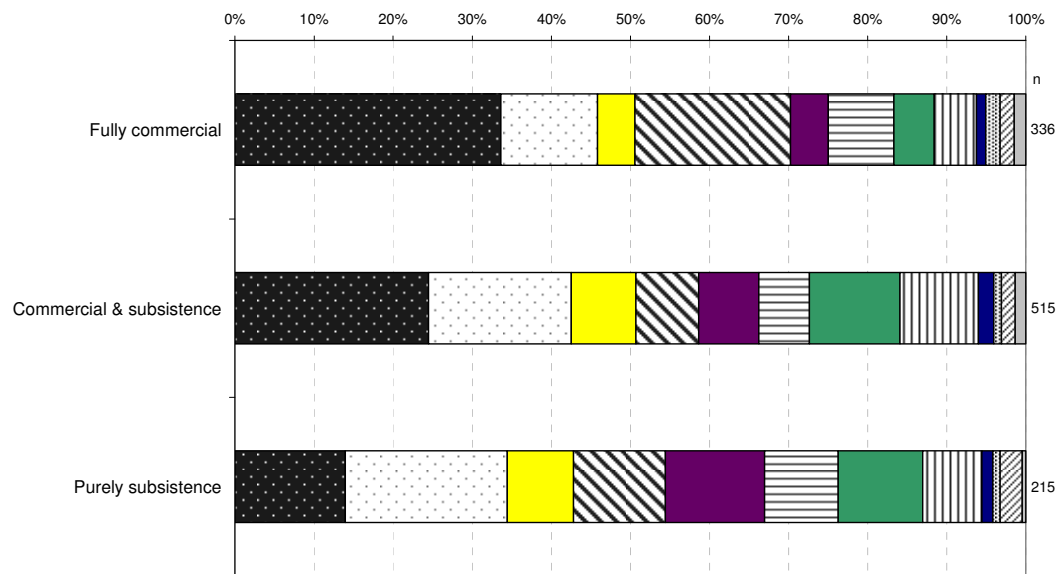
Source: 2009 questionnaire (1066 threats).

■ Economic and market drivers
□ Poor livestock sector policies
■ Socio-political instability
◩ Lack of functional institutions
■ Poor conservation strategies
▤ Disease and disease control
■ Loss of labour force
▥ Loss of production environment
■ Replacement of breed functions
▦ Climate change
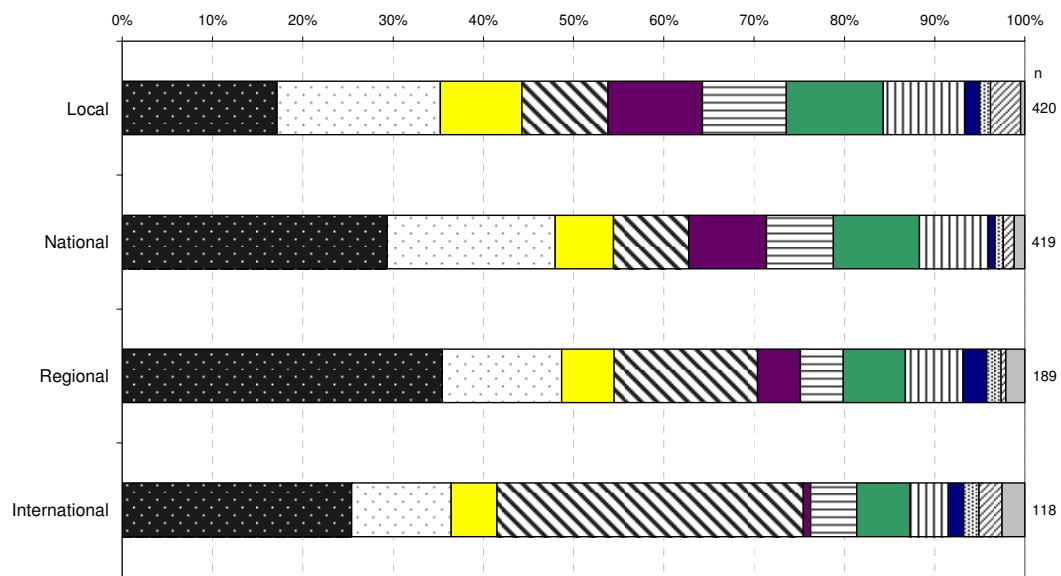▨ Natural disasters
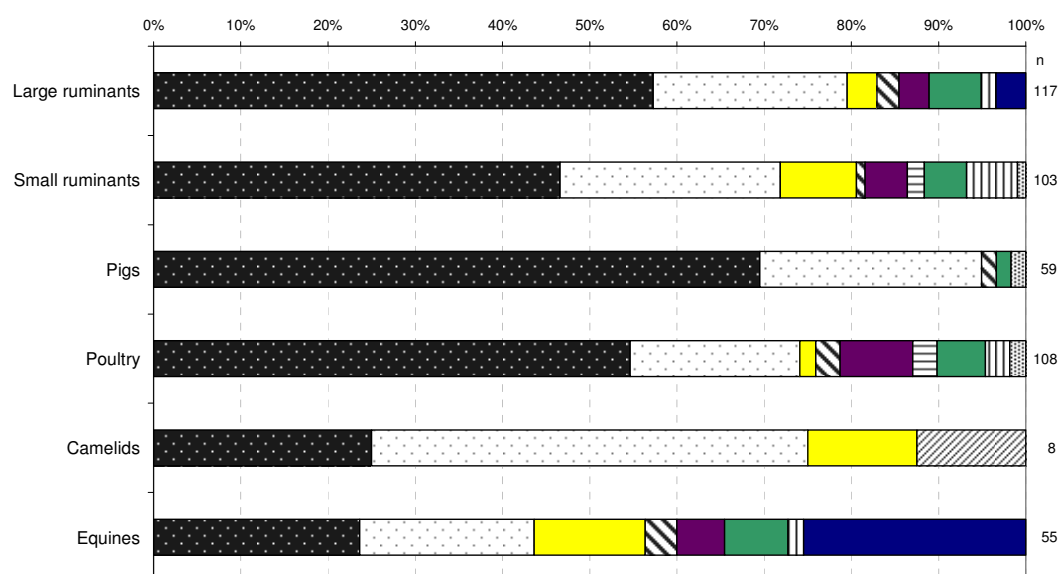■ Use of reproductive technologies

Figure 6. Global distribution of responses for threats, by target market

Source 2009 questionnaire (1066 threats).

- ■ Economic and market drivers
- □ Poor livestock sector policies
- ▨ Socio-political instability
- ◩ Lack of functional institutions
- ■ Poor conservation strategies
- ▤ Disease and disease control
- ■ Loss of labour force
- ▥ Loss of production environment
- ■ Replacement of breed functions
- ▦ Climate change
- ▨ Natural disasters
- ▨ Use of reproductive technologies

Economic and market-driven threats appear to be fundamental in eroding AnGR diversity. They were most frequently mentioned as the first threat for all species groups except camelids and equines. In camelids, poor livestock policies were mentioned by 50 percent of respondents as first-ranked threat while in equines, replacement of breed functions (25 percent) ranked equal to economic drivers (24 percent) (Figure 7).

Figure 7: First-ranked threat by species group
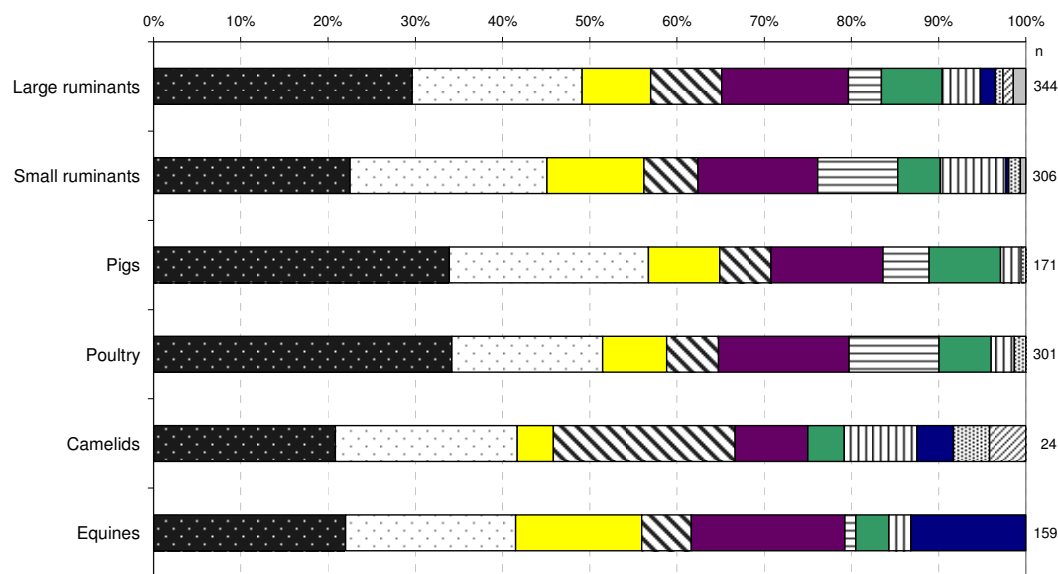

Source: 2009 questionnaire (450 first-ranked threats).

- ■ Economic and market drivers
- □ Poor livestock sector policies
- ■ Socio-political instability
- ◨ Lack of functional institutions
- ■ Poor conservation strategies
- ▤ Disease and disease control
- ■ Loss of labour force
- ▥ Loss of production environment
- ■ Replacement of breed functions
- ▦ Climate change
- ▨ Natural disasters
- ▨ Use of reproductive technologies

Pigs and poultry (34 percent of responses in both cases) followed by cattle (30 percent of responses) are the species groups in which economic and market-driven threats are most often mentioned (Figure 8); these are the species groups with the fastest structural changes to their production systems. The questionnaire did not differentiate between dairy and beef cattle, but it can be assumed that speed of change is faster in the dairy than in the beef sector. Structural change is encouraging regional specialization and, hence, within a given region, may lead to the decline of specialized breeds associated with an unfavoured type of production; it promotes trends towards specialization in a single product at the farm level and, hence, may threaten multipurpose breeds; it promotes capacities to control the production environment and, hence, to utilize a narrower range of breeds; and it facilitates the transfer of genetic material across international boundaries (Tisdell, 2003). The latter factor also promotes the operation of the so-called "Swanson dominance-effect". This term describes a situation in which choices made in the earliest-developing societies strongly affect later patterns of development elsewhere. In the face of a need to rapidly increase production, the choice of transboundary breeds which have already been subjected to many years of intense genetic improvement, and from which genetic material is readily available, is liable to prove attractive to livestock producers and policy-makers in developing countries, even if the development of local breeds might in the longer term provide better adapted animals (ibid.). Indeed, a similar process can operate to reduce within-breed diversity in high-output transboundary breeds – an example being the very widespread use of North American genetic stock in European Holstein-Friesian cattle (FAO, 2007b). The 2005 questionnaire differentiated between "Loss of economic viability through market changes and consumer demands" and "Loss of economic viability through changes in production systems", both of which were covered by "Economic and market drivers" in the analysis of the 2009 questionnaire; the findings were broadly similar in the two surveys.

Figure 8. Global distribution of responses for threat categories

a) by species group

Source: 2009 questionnaire (1305 threats).

a) by species
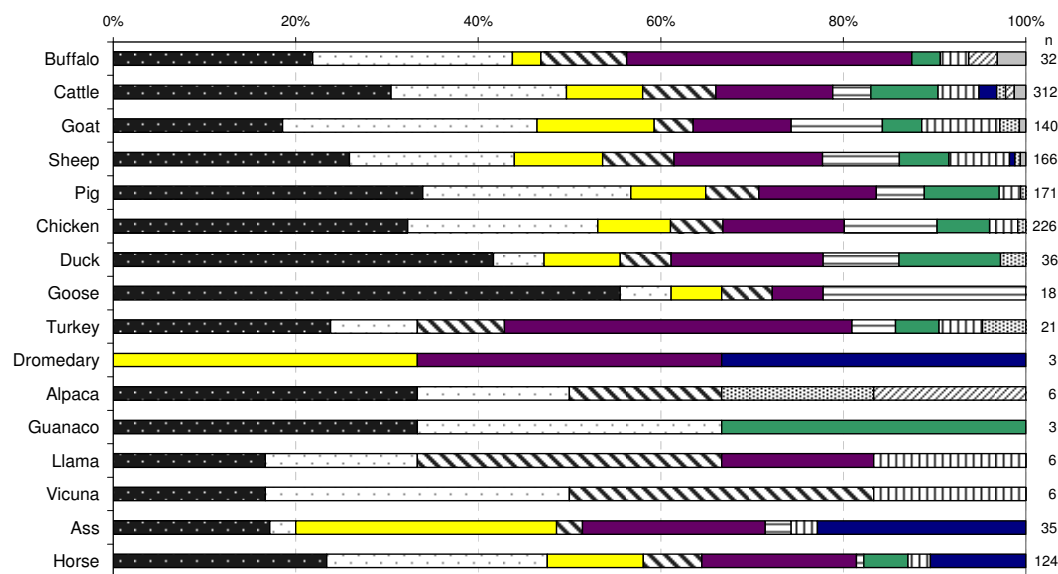
Source: 2009 questionnaire (1305 threats).

■ Economic and market drivers
□ Poor livestock sector policies
■ Socio-political instability
◩ Lack of functional institutions
■ Poor conservation strategies
▤ Disease and disease control
■ Loss of labour force
▥ Loss of production environment
■ Replacement of breed functions
▨ Climate change
▨ Natural disasters
□ Use of reproductive technologies

Interestingly, socio-political instability was mentioned as an important threat for dromedaries (33 percent) and asses (29 percent) species found particularly in drylands, which are often

subject to conflict. In both species, the replacement of breed functions was also frequently mentioned as a threat (33 percent and 23 percent) (Figure 8b).

Results of the 2009 survey of breeds at risk

In contrast to the above-described global assessment, 2009 survey of breeds at risk (identified from DAD-IS and DAGRIS) revealed past and current threats to specific breeds (those that are currently at risk or already extinct). National Coordinators from 61 countries responded and listed 2 193 threats for 952 breeds. Again, economic and market drivers (31.6 percent), poor livestock-sector policies (20.9 percent) and poor conservation strategies (16.7 percent) were the most frequently mentioned. The following threats were mentioned by fewer respondents: socio-political instability (9.8 percent), replacement of breed functions (9.1 percent), lack of functional institutions (5.9 percent), loss of production environment (3.0 percent), loss of labour force (2.0 percent), disease and disease control (0.9 percent) and natural disasters (0.3 percent). Climate change and use of reproductive technologies were not mentioned among the seven threats (maximum) taken into consideration for each breed. The ranking of the main threats corresponds with the 2009 questionnaire results. Replacement of breed function is mentioned more frequently, and loss of labour force and diseases and disease control are mentioned less frequently in the breed survey than in the questionnaire.

In the case of pig breeds, economic and market-drivers were mentioned as the cause of current risk status more often than any other group of threats (47 percent of responses); the equivalent figures for other species groups were 33 percent for small ruminants; and 31 percent for both poultry and large ruminants (Figure 9). In large and small ruminants, poor livestock sector policies were the second most frequently mentioned threat (30 percent of responses in both groups of species). Poor conservation strategies were considered to be important threats in pigs (21 percent of responses) and poultry (18 percent). In rabbits, replacement of breed functions (61 percent) and economic and market drivers (39 percent) were the only threats mentioned. In equines, replacement of breed function, economic and market drivers and poor livestock sector policies were mentioned with similar frequencies (20–22 percent).
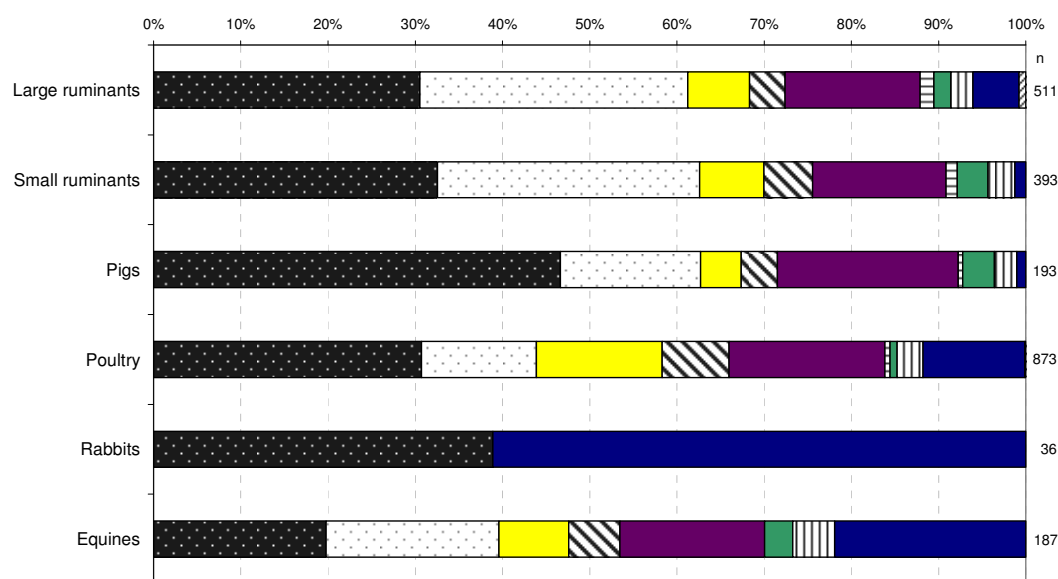
Figure 9. Global distribution of responses identifying threats to breeds at risk, by species group

Source: 2009 breed survey (2193 threats).

- ■ Economic and market drivers
- □ Poor livestock sector policies
- ■ Socio-political instability
- ◩ Lack of functional institutions
- ■ Poor conservation strategies
- ▤ Disease and disease control
- ■ Loss of labour force
- ▥ Loss of production environment
- ■ Replacement of breed functions
- ▦ Climate change
- ▨ Natural disasters
- ▨ Use of reproductive technologies

Economic and market drivers were more frequently mentioned as threats to international transboundary breeds than to regional transboundary and local breeds (Figure 10). In international transboundary breeds, poor conservation strategies are the second most frequently mentioned threat (38 percent). For local and regional transboundary breeds, poor livestock-sector policies (22 and 21 percent), socio-political instability (15 and 18 percent), and replacement of breed functions (9 and 12 percent) follow as the most frequently mentioned threats.

Figure 10. Global distribution of responses identifying threats to breeds at risk, by local and transboundary breeds
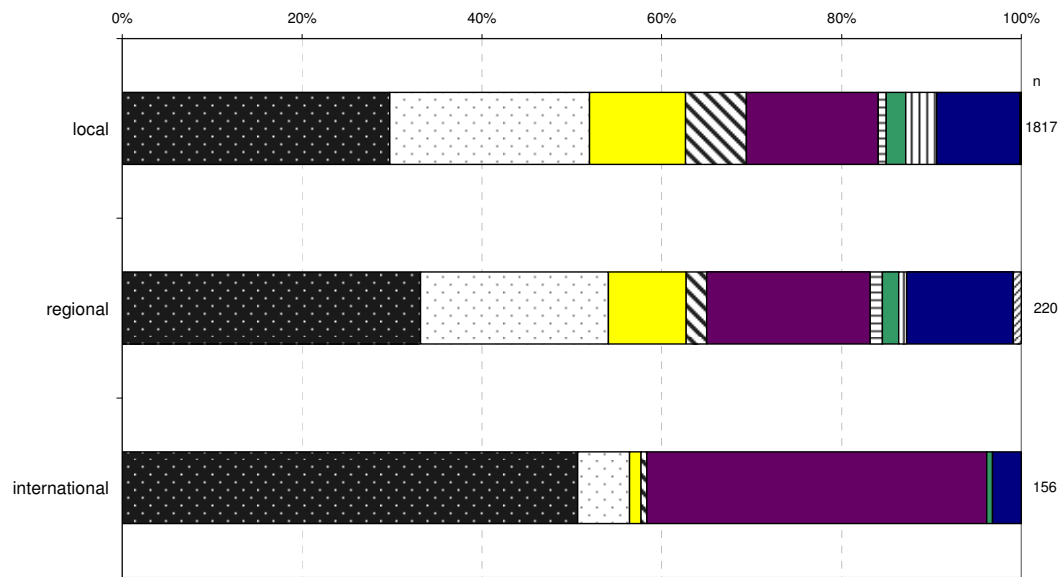

Source: 2009 breed survey (2193 threats).

■ Economic and market drivers
□ Poor livestock sector policies
□ Socio-political instability
◩ Lack of functional institutions
■ Poor conservation strategies
⊟ Disease and disease control
■ Loss of labour force
Ⅲ Loss of production environment
■ Replacement of breed functions
▨ Climate change
▨ Natural disasters
▨ Use of reproductive technologies

For all breeds that are not yet extinct, economic and market drivers are the most frequently mentioned threats (Figure 11). For extinct breeds, poor conservation and poor livestock sector policies were the most frequently mentioned as drivers (29 percent and 24 percent, respectively).

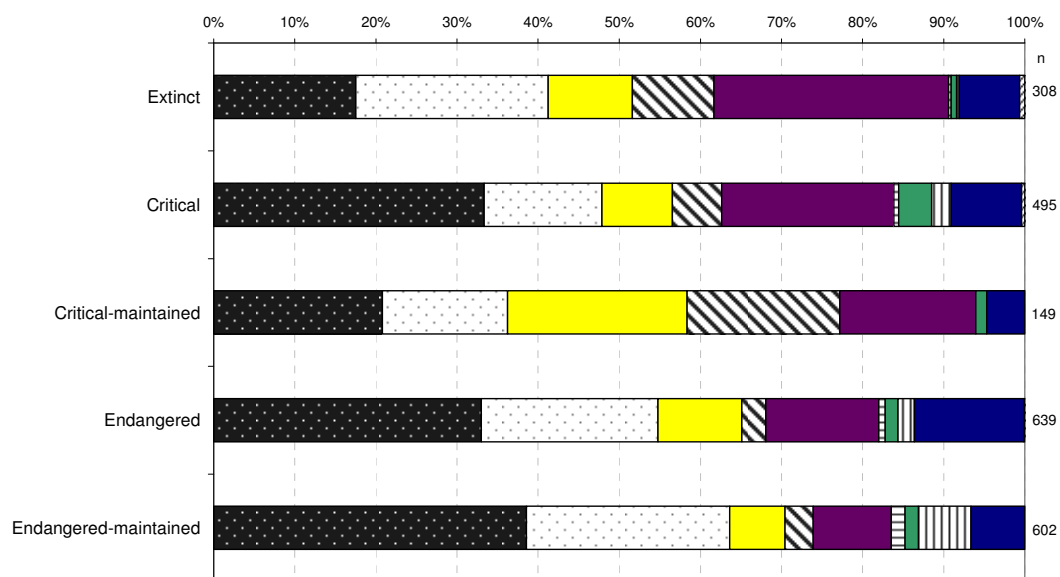**Figure 11.** Global distribution of responses for threats of breeds at-risk, by risk status of breeds

Source: 2009 breed survey (2193 threats).

- ■ Economic and market drivers
- □ Poor livestock sector policies
- ■ Socio-political instability
- ◣ Lack of functional institutions
- ■ Poor conservation strategies
- ▤ Disease and disease control
- ■ Loss of labour force
- ▥ Loss of production environment
- ■ Replacement of breed functions
- ▦ Climate change
- ▨ Natural disasters
- □ Use of reproductive technologies

Trends in the dynamics of threats

The results of the 2005 and 2009 questionnaires both show that the effects of threats to AnGR are most frequently felt at the national level, the most common timescale for impacts to be observed is 1-5 years, and the most common pattern of occurrence is continuous (Tables 1a and 1b). Although a majority of the respondents indicate that the effects of most threats are felt at the national level, it is important to note that the immediate impacts occur locally (i.e. in the environment where the breeds are kept). Therefore there is a need to ensure that any interventions planned at the national level to counter threats are not neglected at local level.

The results of the two surveys differ slightly with respect to the future trends. In 2005, a majority of respondents expected threats to increase, while in 2009 the most frequently expressed opinion was that threats would remain at a constant level. This may be a consequence of timing: the 2005 survey was conducted shortly after the first highly pathogenic avian influenza crisis which gave rise to concerns about potential threats to AnGR caused by the disease and the slaughter policies implemented to control it. Conversely, the assumption may be that certain threats, such as the economic and market drivers, have established themselves at a constant level.

Table 1a. Distribution of responses to reveal the overall trend in the dynamics of threats (2005 questionnaire)

Spatial scale	% resp- onses	Time frame (yrs)	% resp- onses	Frequency of occurrence	% resp- onses	Future trend	% resp- onses	Degree of impact (%)	% resp- onses
Local	14.8	< 1	9.1	Once a year	11.1	**Increasing**	**55.9**	< 5	13.1
National	**31.2**	**1 - 5**	**36.2**	**Once in 10 years**	**37.9**	Decreasing	16.6	**5-10**	**22.8**
Sub-regional	15.0	5 - 10	26.4	Once in 50 years	9.0	Constant	27.5	10-20	22.3
Regional	10.5	> 10	28.4	< once in 50 years	5.2			20-30	19.2
Global	28.4			Continuous	36.8			> 30	22.6
Number of responses	858		838		826		808		819

Table 1b. Distribution of responses to reveal the overall trend in the dynamics of threats (2009 questionnaire)

Spatial scale	% resp- onses	Time frame (yrs)	% resp- onses	Frequency of occurrence	% resp- onse	Future trend	% resp- onses	Degree of impact (%)	% resp- onses
Local	22.9	< 1	5.6	Emerging	7.5	Increasing	32.4	**< 25**	**42.4**
National	**64.5**	**1 - 5**	**47.6**	**Continuous**	**77.6**	Decreasing	22.3	25 – 50	34.6
Sub-regional	6.2	5 - 10	29.0	Recurring	8.7	**Constant**	**44.3**	50 – 75	13.3
Regional	6.4	> 10	17.8	Rare	1.5			> 75	9.7
				Seasonal	4.7				
Number of responses	1305		1305		1305		1305		1305

One interesting observation drawn from the responses is that many threats are expected to reduce population sizes but not to lead to the extinction of breeds. The majority of the responses in the 2005 survey indicated that specific threats would cause the loss of 5–10 percent of the affected breed population, the corresponding figure in the 2009 survey was <25 percent. These findings may reflect a perception among respondents that increased awareness of threats to AnGR will lead to counter-measures being put in place before breeds are lost; another factor may be a view that extinctions usually have multiple causes.

4.2.   Dynamics of individual threats

The dynamics of individual threats are shown in Figures 12a to 12f. It is clear that according to the perceptions of the respondents that the dynamics of individual threats differ.

Most threats affect breeds at the local and national level, except climate change which is clearly recognized by the respondents to have a regional (2009 questionnaire) and global (2005 questionnaire) dimension. Natural disasters and diseases and disease control are also seen to range beyond national boundaries (Figure 12a).

The importance of economic and market drivers was echoed in a recent discussion in DAD-Net. Yang Hongjie (China) mentioned that "ten years ago ... indigenous breeds rather than broilers dominated the chicken meat market in China. We have been optimistic that local chicken breeds were less threatened because of their special flavour and Chinese consumers' preference. But the reality is that broiler meat produced in industrial systems is becoming more and more prevalent; the trade is so significant that it even gives rise to an international trade dispute. Meanwhile, yellow chicken meat (local breeds) is driven towards becoming merely a niche product, even though we've invested huge amounts of funds in conservation. It is time to review and re-think about our conservation and utilization strategy carefully and seriously." Peter Manueli (Fiji) replied that in at least two countries in the Pacific "local broiler industries have been wiped out by cheap chicken-meat imports, local industries were not able to compete because of the high costs of feed imports." Workneh Ayalew (Papua New Guinea) wrote that "a growing industrial broiler production has put a similar enormous pressure on indigenous chicken markets in much of the country [Papua New Guinea]. The industry uses one or two highly specialized exotic broiler breeds and is highly vertically integrated. It supports itself all the way from technology development to market promotion and even lobbying."

Source: DAD-Net September 2009.

With regard to the time span of the impact of threats, the most frequent responses were that the effects of loss of labour force, poor livestock policies, natural disasters and climate change for breed diversity would become evident over relatively long time spans (>5 years), while socio-political instability, lack of functioning institutions, diseases and disease control, use of reproductive technologies loss of production environment and replacement of breed functions would become evident in shorter time spans (<5 years) (Figure 12b). Climate change was considered an emerging threat; diseases and disease control were considered recurrent threats (Figure 12c). Natural disasters, and diseases and disease control were perceived to be the threats that are most seasonal in their occurrence.

The decreasing trend foreseen by respondents for impacts on breed diversity of the use of reproductive technology, natural disasters and lack of functional institutions can be interpreted as indicative of some optimism that the management of these threats will improve over time. On the other hand, more than 50 percent of respondents consider that threats related to climate change, loss of breed function and loss of production environment will increase in the future (Figure 12d). The expectation that the negative effects of poor conservation strategies, use of reproductive technology, lack of functional institutions and loss of labour force will decrease or remain constant may be attributable to expectations that the situation will improve as a consequence of the adoption and implementation of the GPA.

The results of the 2005 and 2009 surveys both show that for all threats, between 20 and 50 percent of respondents expected specific threats to lead to falls of less than 25 percent in affected breed populations (Figure 12e). They also agree that the highest proportions of population losses are likely to be attributable to the use of reproductive technologies, and diseases and disease control.

Breeding strategies and reproductive technologies when seen as threats to AnGR were perceived to have national impacts. An example is the Dairy Development and Poultry Improvement Programmes implemented in Kenya during the 1990s to improve milk and egg production. These programmes were planned and executed at the national level. Artificial insemination programmes which involved the distribution of subsidized semen of exotic breeds (Friesian, Ayrshire, etc) were carried out countrywide. Similarly, poultry improvement involved cockerel exchanges in which farmers exchanged their indigenous cocks for improved cocks provided by the governments. Although these were programmes had noble objectives their implementation led to the dilution of the indigenous gene pool and in some administrative regions led to the complete extinction of indigenous breeds such as the Kikuyu Zebu in central Kenya (Rege,

1999). The fact that an equal proportion of respondents were of the opinion that the effects of breeding strategies can be observed in 1–5 years or 5–10 years is understandable. The speed of the effect depends on the generation interval of the species of interest and the length of the breeding programmes.

> Solomon Abegaz (Ethiopia) related the use of modern reproductive biotechnologies to breeding policy. "In the case of Ethiopia, the country has no breeding policy and artificial insemination is predominantly used in cross-breeding programmes. However, the cross-breeds are never monitored and in the absence of controlled breeding dilution of indigenous breeds is rampant. It is difficult however to attribute the genetic dilution to the extensive use of artificial insemination (except for the use of a small number of bulls which would narrow the gene pool) since similar effects are possible when exotic bulls are used under natural mating. The other reproductive biotechnologies (embryo transfer, multiple ovulation, etc) are not commonly used in Ethiopia."

Source: DAD-Net e-conference, May 2009.

Climate change is a slow process and animal populations can be expected to adapt to such changes, at least to some degree. Livestock keepers also adopt strategies to mitigate the negative effects of climate change such as feed preservation in case of drought or migration in search of pastures.

> Nichol Nonga (Secretariat of the Pacific Community) provided specific examples of the effects of climate change and natural disasters and the damages they cause in the countries of the Southwest Pacific. He pointed out that the negative effects of threats were increasing and were becoming an annual phenomenon in his region.

Source: DAD-Net e-conference, May 2009.

Loss of labour force is projected to increase in future. Loss of labour force is caused to a large extent by increased rural–urban migration, particularly of young men in search of employment. Sickness and death among the middle aged as a result of HIV-AIDS is also a contributing factor.
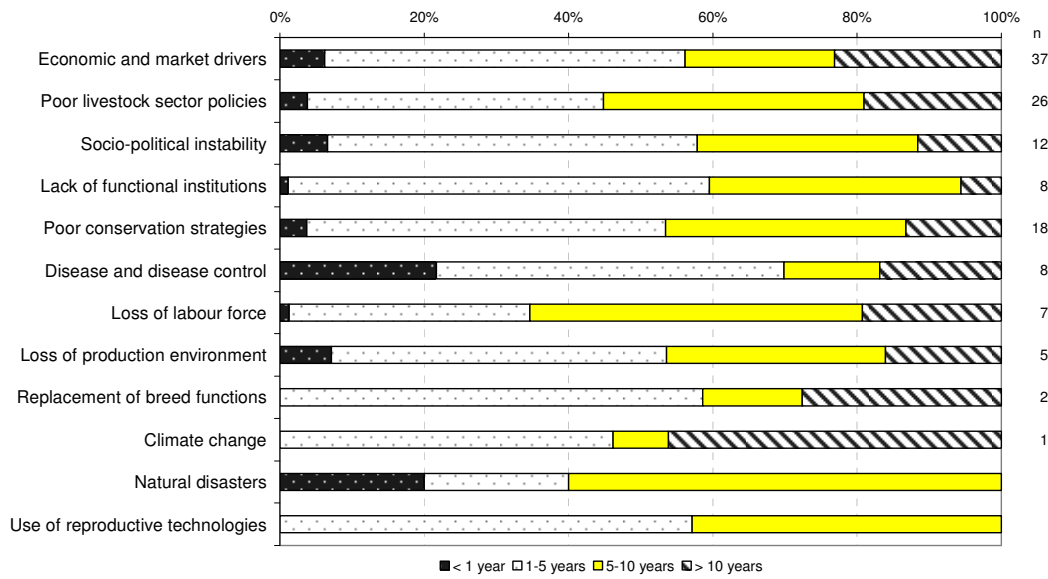
Figure 12. The dynamics of individual threats

a. The spatial scale at which individual threats affect livestock breeds
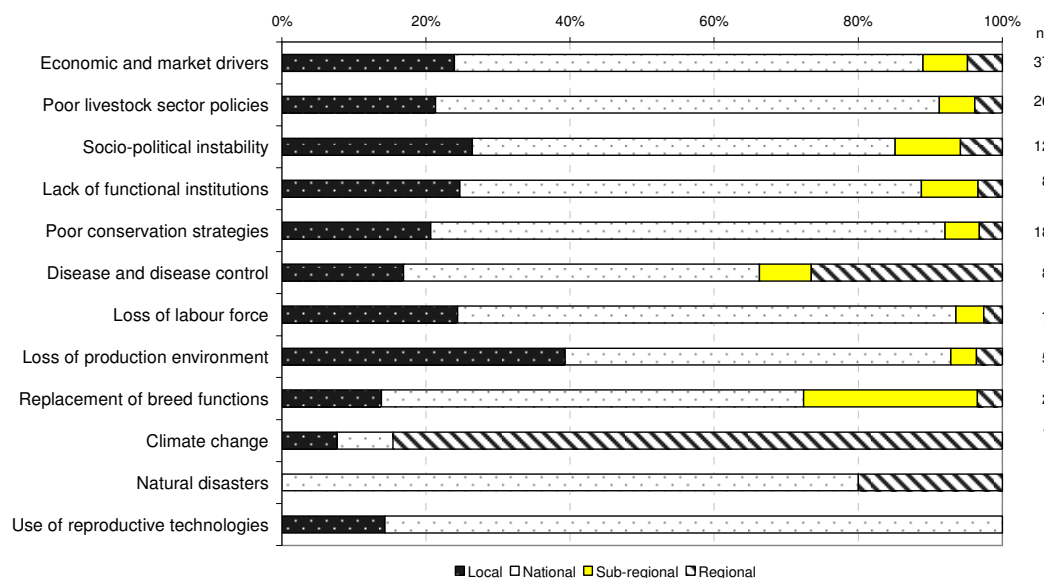
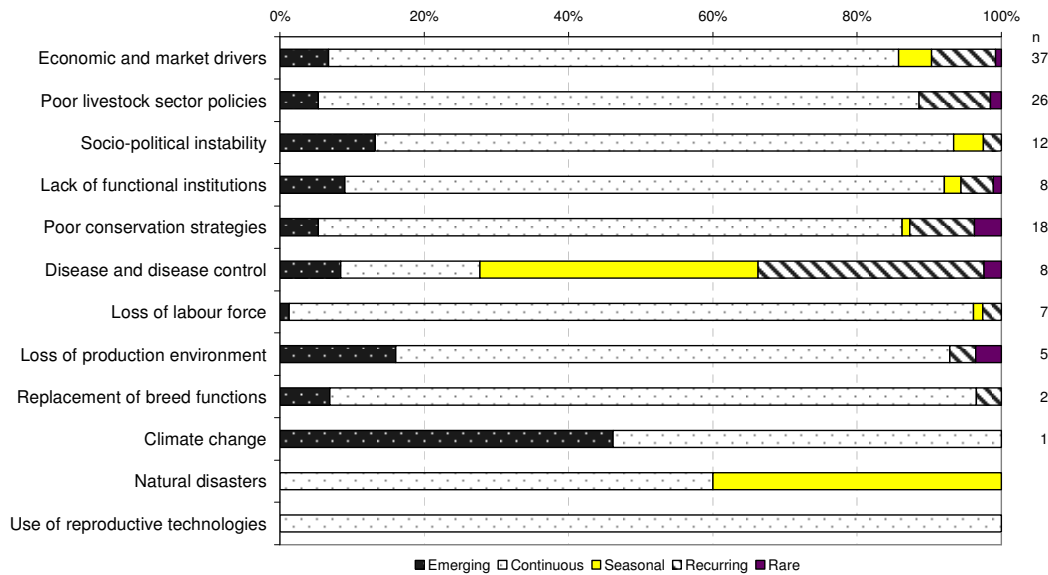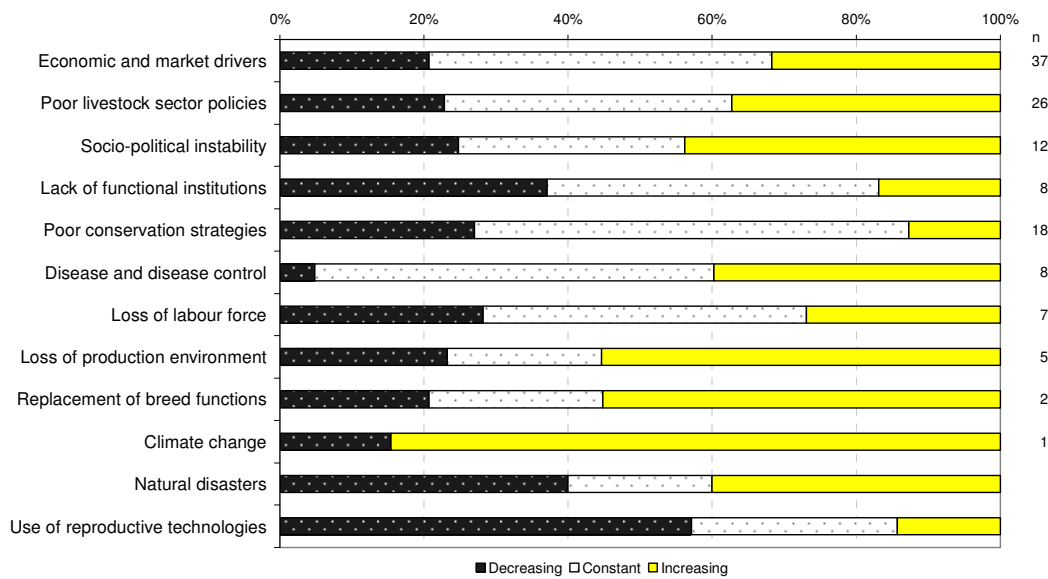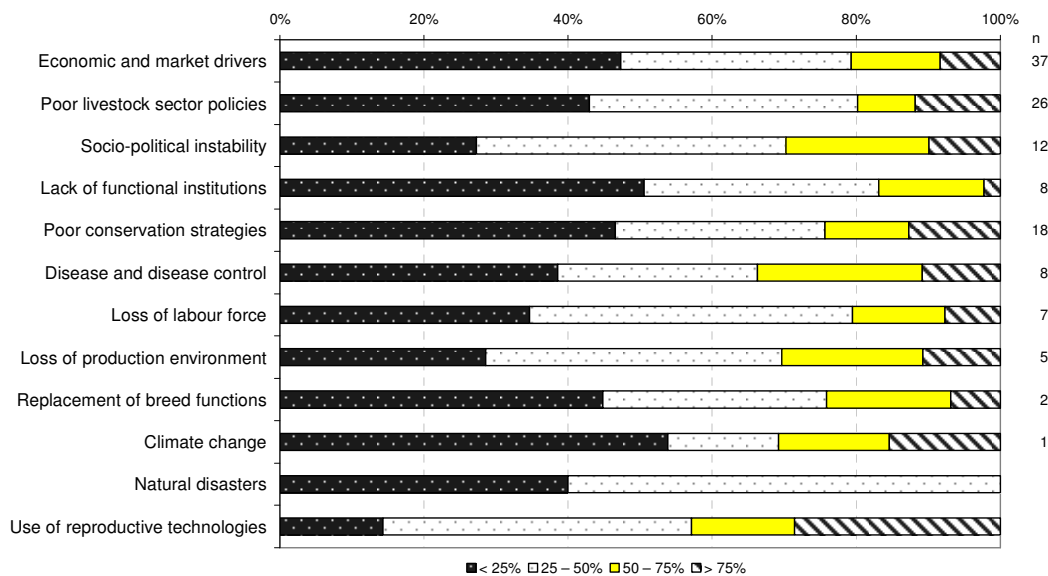b. Time span over which the effect of the threat on breed diversity becomes evident

■ < 1 year   □ 1-5 years   □ 5-10 years   ⊠ > 10 years

c. Frequency of occurrence of individual threats

■ Emerging   □ Continuous   □ Seasonal   □ Recurring   ■ Rare

d. Future trends of individual threats

e. Estimated degree of impact of individual threats to breed diversity

Source: 2009 questionnaire (1305 threats).

4.3.   Conservation strategies

The conservation strategy most frequently favoured as means to counter threats was a combination of *in situ* and *ex situ in vitro* conservation. This preference is probably a consequence of a recognition on the part of respondents (2005 questionnaire) that such a strategy can conserve AnGR both within their production environments, where they have opportunities to adapt to changing environmental conditions, and in gene banks (as semen, embryos, etc.) from which they can be accessed to reconstitute a breed and are safe from disasters such as disease outbreaks. Respondents' preferences with respect to conservation strategies did not differ from one threat to another.

The replacement of breed functions is a threat, but it is also an opportunity. This is evident from the large number of hobby breeds – especially among poultry and to some extent among horses – that are maintained with low population numbers by enthusiasts. If their numbers plummet

because of generation change in livestock-keeping communities, zoosanitary standards or other regulations, these breeds will become more endangered. Modern reproductive biotechnologies (artificial insemination, multiple ovulation, embryo transfer, *in vitro* fertilization, etc.) are also not a threat to AnGR if they are used in well-structured breeding programmes.

> Salah Galal (Egypt), Sassamma Iype (India), Maria da Gloria Taela (Mozambique), William Vivanco (Peru) and Mamadou Sangare (Burkina Faso) were of the opinion that reproductive technologies can play an important role in conservation programmes, in achieving increased productivity, in developing synthetic breeds for specific needs and in the reconstitution/recovery genetically eroded breeds. The threat associated with these technologies arises from inappropriate decisions being taken in genetic improvement programmes – or the lack of such programmes – the consequence being the uncontrolled use of reproductive biotechnologies to disseminate inappropriate genetics.

Source: DAD-Net e-conference, May 2009.

Table 3. Conservation strategies

Conservation strategy	% responses (829)
In situ	14.7
Ex situ in vivo	5.7
Ex situ in vitro	9.2
In situ + ex situ in vivo	18.3
In situ + ex situ in vitro	**28.8**
Ex situ in-vitro + ex situ in vivo	15.4
Others	7.8

Source: 2005 questionnaire.

Figure 13. Best conservation strategy to counterbalance threats
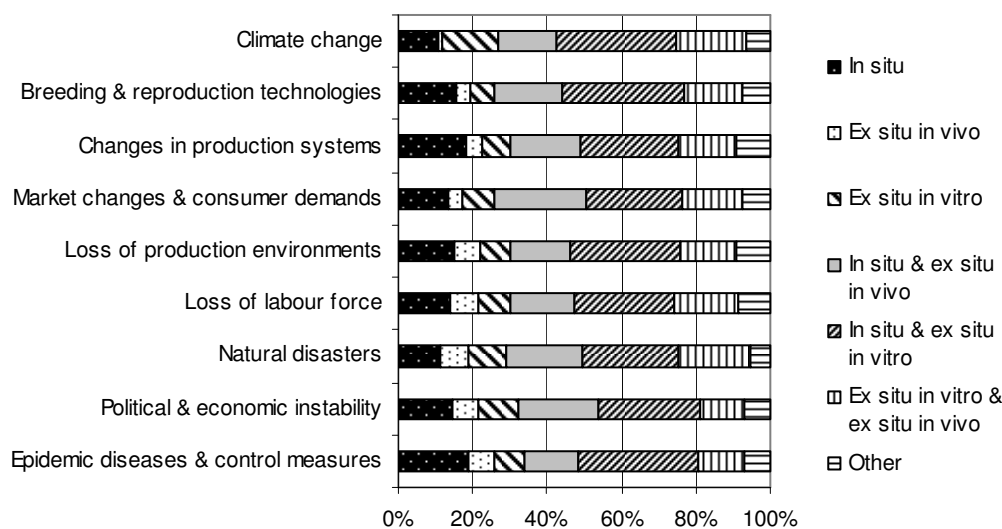
Source: 2005 qustionnaire.

Adam Drucker (Bioversity International) commented that "livestock-keepers cannot be expected, nor can afford, to safeguard public good values without the appropriate incentives to do so. The fact that such incentives are largely absent or even heavily biased towards non-indigenous breeds is a failure of national policy frameworks and associated underfunding and lack of capacity. The existence of both bias and a lack of incentives means that as the development process proceeds and livestock-keepers can afford more and often subsidized inputs (e.g. feed, veterinary care, artificial insemination, transport to market), they will find it profitable to move away from using breeds (usually indigenous) that are appropriate for low-input/low-output systems. Furthermore, they will tend to do so at a much earlier point in the development process than they would have otherwise. The existence of such a turning point has implications for the design of cost-effective conservation policies. Prior to reaching the turn-over point, livestock-keepers still find their livelihoods best served by indigenous breeds. Conservation can thus be achieved through continued sustainable use. Beyond the change-over point, explicit conservation mechanisms and incentives would need to be provided to compensate the livestock-keeper for the benefits forgone (i.e. the opportunity cost) from not changing to a non-indigenous breed. However, it may well also be that reaching such a change-over point is not inevitable, given the potential of some indigenous breeds to respond well to improved management and the potential for niche markets for its products to be developed. Unfortunately, unbiased comparative analyses of indigenous *versus* non-indigenous breeds under the kind of production systems typically found in developing countries have been extremely rare".

Source: DAD-Net e-conference, May 2009.

5.   CONCLUSIONS

1.   Threats to AnGR are real and operate at various levels. No threat is considered unique to a particular AEZ or LPS, but the frequency and impact of threats differs between LPS and AEZ.

2.   Most threats affect breeds at local and national level. The main threats to AnGR are economic and market driven, which means they are beyond the direct control of the livestock sector. The second and third most frequently mentioned threats – poor livestock sector policies and poor conservation strategies – are within the control of the livestock sector.

3.   There is divided opinion on the dynamics (future trend, proportion of population likely to be lost, spatial scale, frequency of occurrence and time span) of threats. There is need for well-designed studies to collect data that can be used to assess these dynamics for each threat.

4.   The two methods used (general questionnaire and *ex post* attribution to breeds at risk) produced similar results. However, the timing of questionnaires tends to influence responses to a certain extent. *Ex-post* explanations do not reflect possible future trends of threats (e.g. of climate change).

5.   Breeds are usually exposed to more than one threat. Eliminating one threat does not necessarily guarantee the safety of the breed.

6.   A common perception among respondents was that most single threats will not lead to the extinction of breeds.

7.   Most of the identified threats can be managed with concerted efforts from both the private and public sectors. This has to be considered when designing policy, institutional and technical interventions.

8.   Conservations strategies should combine *in situ* and *ex situ* methods.

9.   Many threats can be directly addressed by governments, through market-based or regulatory policy tools. The most evident among these are poor livestock-sector policies, poor conservation strategies, socio-political instabilities and lack of functional institutions.

10.   Governments that want to achieve an impact at national level should address economic and market drivers, poor livestock-sector policies and poor conservation strategies. The use of reproductive technologies, in combination with uncontrolled cross-breeding, which is can have a rapid impact and which may affect a large proportion of the population, needs to be also addressed. Diseases and disease control, and climate change impacts need to be addressed at supra-national levels.

11.   If governments want to take action that will rapidly contribute to reducing threats to AnGR they should address diseases (especially the recurring ones) and disease control, and economic and market drivers. Improving livestock-sector policies, institutions and conservation strategies will bear fruit in the medium term (>5 years). In the long term, climate change will need more attention.

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**ANNEX 1:   SURVEY QUESTIONNAIRE – 2005: THREATS TO FARM ANIMAL
                 GENETIC RESOURCES**

Annex 1.1   Questionnaire – 2005

Background

The International Conference on Options and Strategies for the Conservation of Farm Animal
Genetic Resources organized by the Systemwide Genetic Resources Programme of the CGIAR,
FAO and AGROPOLIS took place in Montpellier, 7-10 November 2005. Around 60
participants from round 28 countries were present. The conference reviewed the current state of
livestock conservation initiatives and the current knowledge of options and constraints for
livestock conservation schemes, taking into account the complementarities of ex-situ and in-situ
conservation. It became clear that interventions to halt the decline of breed diversity, and the
respective conservation methods, depend on the various roles and functions of livestock on the
one side, and the spatial scale and number of animals affected by the threat and the timeframe of
the threat that ultimately influences the reaction time on the other side.

FAO therefore now invites a large number of stakeholders from all regions to assess and rank
the threats for breed diversity of all major domestic animal species, for developing a better fit
between threats and conservation methods. The results will be used for the first Report on the
State of the World's Animal Genetic Resources.

The questionnaire contains a standard set of seven questions that is repeated for each of the
following nine threats:

-   Epidemic diseases and their control measures
-   Political and economic instability
-   Natural disasters
-   Loss of labour force
-   Loss of production environments
-   Loss of economic viability through changes in markets and consumer demands
-   Loss of economic viability through changes in livestock production systems
-   Breeding strategies and reproduction technologies
-   Climate change

1.   From which country do you come?

2.   Which type of organization do you represent?
-   Ministry
-   University / teaching
-   Research institute
-   Extension service
-   Veterinary service
-   Genebank or other conservation unit
-   Private Sector (breeding organisation or company, Artificial insemination centre,
    Biotechnology company)
-   Livestock breeder / keeper / farmer
-   NGO
-   Regional body / Regional economic organisation
-   Other (please specify)
-

3.   What is your highest educational degree?
Technician   BSc   MSc PhD

4.   Please indicate whether you are
female   male

The nine threats were:

Epidemic diseases and their control measures
Epidemic diseases are contagious diseases, for example avian flu, foot-and-mouth disease, rinderpest, contagious bovine pleuropneumonia, Rift Valley fever, African and classical swine fever, and many others listed by the World Organization for Animal Health (OIE). Control measures include vaccination or stamping out.

Political and economic instability
Examples for this threat are wars and civil conflicts, or other rapid political and economic changes (e.g. the transformation of centrally planned into market economies).

Natural disasters
Natural disasters are for example drought, earthquake, flood etc.

Loss of labour force
Loss of labour force for animal and breed management can be qualitative, through the loss of local knowledge, or quantitative, through the reduction of available workforce. Examples are rural out-migration to urban centres, or HIV/AIDS.

Loss of production environments
The production environment of a breed can be reduced due to environmental degradation (e.g. rangeland degradation or water pollution) or competition for natural resources through other uses (e.g. mining, nature protection).

Loss of economic viability through changes in markets and consumer demands
Changes in demands for livestock products and services can be driven by changes in local, regional or international trade regulations (policy constraints, World Trade Organization agreements, health regulations etc) or demand for new products.

Loss of economic viability through changes in livestock production systems
Loss of economic viability of breeds can be caused by changes in livestock production systems, including the switch to more intensive and larger scale production systems, and new forms of organization (e.g. vertical integration).

Breeding strategies and reproduction technologies
This includes strategies and programmes for genetic improvement such as crossbreeding or breed replacement, and the use of reproduction technologies such as artificial insemination.

Climate change
The effect of climate change is expected to differ between regions and between agro-ecosystems within regions.

For each threat, six questions were asked *viz*:

1.   What is the spatial scale of the threat to livestock breeds?
local   national   subregional (e.g. West Africa, East Asia)
regional (e.g. Asia, Europe)   global

2.   **In which time frame will the effect of the threat on breed diversity become evident?**

extremely fast / evident in less   very fast / evident in less
than 1 year   than 3 years

fast / evident in less than 5 years   medium / evident in less than 10 years

slow / evident in 10 to 20 years   very slow/ evident in the long term (more than 20 years)

3.   **How probable is the threat to occur?**

once per year   once per 10 years   once per 50 years   less than once per 50 years

continuous

4.   **How do you see the threat developing in future (next 20 years)?**

decline substantially   decline somewhat   constant

increase somewhat   increase substantially

5.   **How big is the impact of the threat? In the worst case scenario, what proportion of the population might be lost?**

few (less than 5%)   some (5 to 10%)   medium (10 to 20%)

many (20 to 30%)   very many (more than 30%)

6.   **What conservation strategy is the best to counterbalance the threat?**
in situ (live animals)
ex situ in vivo (live animals in a station, farm park, zoo etc)
ex situ in vitro (frozen semen, embryos, oocytes, somatic cells)
in situ + ex situ in vivo   in situ + ex situ in vitro
ex situ in vitro + ex situ in vivo
Other (please specify)

7.   **Do you have any further comments or observations regarding this threat in your country or region?**

Thank you

This is the end of the questionnaire. We thank you very much for your time and effort to fill it in.

Annex 1.2   Profile of the respondents – 2005

Which type of organization do you represent?

Response	*Total*
Ministry	33
University / teaching	67
Research institute	41
Extension service	2
Veterinary service	4
Genebank or other conservation unit	6
Private Sector (breeding organization or company, artificial insemination centre, biotechnology company)	5
Livestock breeder / keeper / farmer	10
NGO	20
Regional body / regional economic organisation	3
Other (please specify)	12
Total respondents	**203**

What is your highest educational degree?

Response	*Total*
Technician	6
BSc	20
MSc	63
PhD	110
Total respondents	**199**

Please indicate whether you are

Response	*Total*
Female	50
Male	149
Total respondents	**199**

ANNEX 2:   SURVEY QUESTIONNAIRE – 2009: ANALYSING THREATS TO ANIMAL GENETIC RESOURCES

Annex 2.1   Revised classification of threats to animal genetic resources

A.   Threats related to economics and modern technological innovations

A1. Economic and market driven threats:
- changes in livestock production systems, producer objectives and reduced economic competitiveness of breeds
- changes in market and consumer demands/preferences
- economic instability, unfavourable trade agreements, currency devaluations etc.

A2. Replacement of breed functions e.g.:
- agricultural mechanization and motorization
- use of inorganic fertilizers instead of manure

B.   Threats Related to Human Dynamics

B1. Loss of labour force
- rural-urban emigration and urbanization
- prevalence of HIV/AIDS
- heavy human mortalities
- disruption/loss of traditional knowledge and related institutions

B2. Inadequate human capacity
- knowledge
- critical mass
- high turn over rate of skilled human resources etc.

B3. Socio-political changes and upheavals
- wars, internal civil strife and cross border conflicts
- loss of traditional livelihoods, cultural diversity and changing cultural practices
- unfavourable cultural practices such as slaughter of best animals in traditional ceremonies, disposing off the best animals to slaughter houses (negative selection)

C.   Threats Related to Policy Development and Institutional Capacity

C1. Poor/weak livestock sector policies
- poor/lack of appropriate breeding policies and strategies
- inappropriate land reform policies e.g. subdivision of large livestock farms into small economically unviable units
- adopting policies that promote the utilization and consumption of imported livestock genetics and products
- unfavourable patents of livestock and livestock products
- exclusion of private breeding companies, NGOs, livestock keepers etc in forums on the sustainable utilisation of AnGR
- non-implementation of breeding policies and strategies

C2. Lack of functioning and/or the presence of poor/weak institutions and facilities for AnGR

- poor/lack of monitoring activities and early warning systems for AnGR including the lack of animal identification and performance recording
- poor/lack of adequate technical facilities, institutions and programmes to support, conserve and promote AnGR

C3. Poor/lack of conservation strategies

- poor/lack of awareness of the economic and biological value or merit of different livestock breeds and especially their non-productive qualities (fertility, hardiness etc)
- lack of strong justification and political will to support AnGR related activities and programmes
- absence of genebanks/conservation units for AnGR

C4. Threats related to breeding programmes and use of modern reproductive biotechnologies

- absence of effective and well structured breeding programmes:
  - use of only a few popular sires for breeding
  - indiscriminate use of exotic animals for crossbreeding
  - uncontrolled inbreeding
  - uncontrolled interbreeding
  - importation of breeds
  - replacing and/or substituting local breeds with crossbred and/or pure bred exotic animals etc
- poor/lack of appropriate knowledge on how best to match genotypes to the appropriate environments
- non-implementation of well formulated and structured breeding programmes
- use of modern reproductive biotechnologies e.g. artificial insemination, multiple ovulation and embryo transfer, etc for breeding
- non-availability of pure breeding sires

D. **Threats associated with animal health and hygiene**

- epidemic diseases and their control measures
- prevalence of endemic diseases
- prevalence of ecto- and endo-parasites
- feed and water toxins

E. **Threats related to natural and production environment**

E1. Loss of production environment

- increased competition for natural resources, converting grazing (range) lands to crop farming, irrigation schemes, mining, settlement schemes etc
- establishing protected areas e.g. wildlife parks, recreation sites, forests, etc
- environmental destruction (overgrazing and pollution)
- predation from wild animals, etc

E2. Limited geographic concentration/endemism of breeds

E3. Natural disasters and associated phenomenon

- continuous and prolonged droughts
- famines

- earthquakes
- floods
- typhoons
- hurricanes
- tsunamis
- volcanic eruptions etc

E4. Climate change and associated phenomenon

- global warming
- rising sea levels
- eco-system change etc

Annex 2.2   Questionnaire – 2009

Analysing threats to animal genetic resources

Introduction

Threats to AnGR have increased in recent times. It is a fact, over 20 percent of the world's livestock breeds with documented population information are at risk of extinction, and in the past six years, sixty breeds have been lost; an average of about one breed per month (see *The State of the World's Report on AnGR:* http://www.fao.org/docrep/010/a1250e/a1250e00.htm). This is still a conservative estimate given that the population size and structure of most breeds has not been determined. Furthermore, information that is pertinent to understanding the threats facing AnGR and their effects has not been documented in a systematic manner. Detailed research and analysis is therefore required to define, cluster and assess the scope and operational mechanisms and dynamics of threats facing AnGR. FAO cordially invites you to be an active participant in this process through this questionnaire survey. The survey will link threats to AnGR with the affected breeds, agro-ecological zones and livestock production systems. The expected trend, time scale, magnitude, geographic scope and the best conservation strategy to counter the threat will be determined. Filling the questionnaire should take you approximately one hour. In case you need some clarifications you can reach us by email: DAD-Net@fao.org

Respondent profile

1.   **Which country do you come from?   Country:**

2.   **What type of organization do you represent (multiple responses allowed)?**

Organization	Tick
Government Ministry	
Higher learning institution (University, College)	
Research Institute	
Extension service provider	
Veterinary service provider	
Gene bank/Conservation unit	
Private enterprise/Breeding company	
Livestock breeder/farmer/keeper/trader	
Non-governmental organization (NGO)	

| Regional Body/Economic Organization | |
| Others...................................... (please specify) | |

2.1 Categories / Profile of threats

Below are 12 categories of potential threats to AnGR. These are by no means exhaustive, feel free to add on them. Which ones are prevalent in your country/sub region/region?

A. Threats Related to Economics and Technological Developments

A1.   Economic and market driven threats:

   A1.1   Changes in production systems such as intensification and commercialization

   A1.2   Changes in producer objectives, consumer demands and market preferences

   A1.3   Economic instability due to unfavourable trade agreements (e.g. WTO rules, Free Trade Areas), currency depreciations etc

   A1.4   Market liberalization which favours transition from traditional to industrialized production systems

   A1.5   Reduced economic competitiveness of breeds

A2.   Replacement of breed functions because of technological innovations and developments such as: agricultural mechanization, motorization etc

B. Threats Related to Human Issues/Dynamics

B1.   Loss of human resources (labour force) and know how due to:

   B1.1   Rural-urban migration and urbanization

   B1.2   Loss of indigenous knowledge and institutions

   B1.3   Prevalence of HIV/AIDS

   B1.4   Inadequate human capacity (knowledge, critical mass etc) to handle the AnGR portfolio

B2.   Socio-political upheavals, changes and instabilities due to:

   B2.1   Wars, civil strife, cross border conflicts (within and between-countries) etc

   B2.2   Loss of traditional livelihoods and cultural diversity

   B2.3   Changing cultural practices

   B2.4   Changes in consumption patterns of animal products

   B2.5   Increased poverty levels

   B2.6   Displacement of people as result of war

C. Threats Related to Policy Development and Institutional Capacity

C1.   Poor/weak livestock sector policies and strategies including:

   C1.1   Lack of appropriate breeding policies

   C1.2   Formulation of skewed and misguided breeding policies

      C1.3   Absence of effective well structured breeding programmes leading to indiscriminate crossbreeding and/or inbreeding

      C1.4   Inappropriate importation of breeds, implementation of inappropriate breeding strategies such as the use of only a few popular sires for breeding, breed replacement/substitution, mismatch of genotypes and environments

      C1.5   Interbreeding e.g. between the humped Bos indicus and humpless Bos taurus breeds in West Africa

      C1.6   Indiscriminate use of exotic animal genetic resources for breeding purposes

      C1.7   Policies that promote industrialization of animal breeding such as the consolidation of breeding activities to a few private companies

C2.   Lack of functional institutional frameworks and mechanisms and where they exist, they may be poor/weak:

      C2.1   Lack of adequate technical facilities and programmes to ensure sustainability of AnGR

      C2.2   Poor or lack of monitoring activities and early warning systems for AnGR

      C2.3   Skewed/unfavourable patenting of products derived from AnGR

      C2.4   Lack of continuity in the management of AnGR due to high turn over rate of human resources

      C2.5   Exclusion of private livestock/breeding companies in forums dedicated to AnGR

      C2.6   Exclusion of livestock keepers/farmers from decision-making processes related to AnGR

C3.   Poor conservation strategies including neglect of AnGR due to:

      C3.1   Lack of valuation of breeds (lack of awareness of the value of breeds)

      C3.2   Lack of a strong justification for the conservation of AnGR

      C3.3   Lack of political will to support AnGR activities

      C3.4   Minimal efforts exerted to study and understand general issues related to AnGR

      C3.5   Non allocation of resources to activities involving AnGR

D.   Threats Related to Animal Biological System

D1.   Threats linked to status of animal health such as:

      D1.1   Epidemic diseases and associated control strategies such as massive culling

      D1.2   Spread of exotic diseases e.g. avian influenza

      D1.3   Prevalence of endemic diseases

      D1.4   Prevalence of ecto- and endo-parasites

      D1.5   Feed and water toxins

D2.   Use of modern reproductive biotechnologies such as

      D2.1   Artificial insemination, multiple ovulation and embryo transfer etc

E.   Threats Related to Natural Environment

E1.   Loss of production environment due to:

    E1.1   Increased competition for natural resources as a result of the need to settle humans, crop farming etc

    E1.2   Establishment of protected areas e.g. wildlife sanctuaries and parks, recreation sites, forests

    E1.3   Accelerated destruction of ecosystems and natural resources (environment) due to overgrazing and pollution (e.g. waste disposal from intensive livestock production systems and other industries)

    E1.4   Limited geographic concentration or endemism of a breed/population (increases the vulnerability of breeds/populations to particular threats)

E2.   Natural disasters such as:

    E2.1   Droughts, famines, earthquakes, floods, typhoons, hurricanes, tsunamis etc

E3.   Climate change (global warming and rising sea levels)

Definitions of livestock production systems

A.   Grassland-based systems: are those in which the animals obtain a large proportion of their forage intake by grazing natural or sown pastures namely:

- ranching or other private grassland systems: are grassland-based systems in which livestock is kept on privately owned range/pasture land.

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

B.   Mixed systems: are those in which livestock keeping is integrated with other agricultural activities, together forming a whole system such as:

- crop–livestock systems: are those in which livestock production is integrated with crop production.

- agropastoralist systems: are livestock-oriented systems that involve some crop production in addition to keeping grazing livestock on rangelands; they may involve migration with the livestock away from the cropland for part of the year; in some areas, agropastoral systems emerged from pastoral systems.

- agroforestry–livestock systems: are those in which livestock production is integrated with the production of trees and shrubs.

C.   Landless systems: livestock production is separated from the land where the feed given to the animals is produced. Examples include:

- industrial systems: are large-scale landless production systems in which the production environment is highly controlled by management interventions.

- backyard/scavenger systems: are small-scale landless production systems in which the animals are kept in backyards or other small areas of land and feed on household waste, externally sourced feeds, and/or what they can obtain from their surroundings.

Part 1

What agro-ecological zones (AEZ) and associated livestock production systems (LPS) are found in your country/sub-region/region? Please provide **FIVE** threats to AnGR that predominate in each AEZ and LPS.

AEZ	LP S	Market Orientation	Target Market	Threat 1	Threat 2	Threat 3	...
...	...	...	..	...	...	...	...

Agro-ecological zones:

>   **1 =** Arid/semi arid;   **2 =** Humid/sub-humid;   **3 =** Highland/temperate

Livestock Production systems:

>   **1** = Grassland-based systems: Ranching/Other private; Pastoralist

>   **2** = Mixed systems: Crop-livestock; Agropastoralist; Agroforestry-livestock

>   **3** = Landless system: Industrial systems; Backyard/scavenger systems

Market orientation: 1 = Fully commercial oriented; **2 =** Commercial and subsistence oriented; **3 =** Purely subsistence oriented

Target markets: 1 = International markets; **2 =** Regional markets; **3 =** National markets; **4 =** Local markets

Part 2.

Note: From this point onwards each page in the automated questionnaire is specific to each group of species.

1.   Select THREE most important breeds for each group of livestock species and provide THREE most important threats faced by each breed in order of importance.

Group	Threat rank 1	Threat rank 2	Threat rank 3
Poultry (Chicken or Duck or Turkey)			
Breed 1 (specify the species)			
Breed ...			
Large ruminants (Cattle or Buffaloes)			
Breed 1 (specify the species)			
Breed ...			
Small Ruminants (Sheep or Goats)			
Breed 1 (specify the species)			
Breed ...			
Mono Gastric (Pigs)			
Breed 1 (specify the species)			
Breed ...			
Equines (Ass or Horse)			
Breed 1 (specify the species)			
Breed ...			
Camelids (Bactrian or Dromedary)			

Breed 1 (specify the species)			
Breed ...			

Comments

2.   What is the expected trend of the three threats faced by each breed specified in the previous question (Qn 2.1.2) [1 = Decrease; 2 = Constant; 3 = Increase]

	Expected trend for the three most important threats to AnGR		
Group	**Threat rank 1**	**Threat rank 2**	**Threat rank 3**
Poultry (Chicken or Duck or Turkey)			
Breed 1 (specify the species)			
Breed ...			
Large Ruminants (Cattle or Buffaloes)			
Breed 1 (specify the species)			
Breed ...			
Small Ruminants (Sheep or Goats)			
Breed 1 (specify the species)			
Breed ...			
Mono Gastric (Pigs)			
Breed 1 (specify the species)			
Breed ...			
Equines (Ass or Horse)			
Breed 1 (specify the species)			
Breed ...			
Camelids (Bactrian or Dromedary)			
Breed 1 (specify the species)			
Breed ...			

Comments:

3.   What proportion of breeds are likely to be lost due to the negative effects of the three most important threats to AnGR [1 = Less than 25%; 2 = Between 25 – 50%; 3 = Between 50 – 75%; 4 = Greater than 75%]

Table adapted from section 5.

Comments:

4.   What is the spatial scale of the three most serious threats to AnGR as specified in question 2.1.2 [1 = Local (within a district, province etc); 2 = National (countrywide); 3 = Sub-regional (West Africa, East Asia etc); 4 = Regional (Africa, Asia etc)]

Table adapted from section 5.

Comments:

5.   What is the frequency of occurrence of the three most important threats to AnGR [1 = Emerging; 2 = Continuous; 3 = Seasonal; 4 = Recurring; 5 = Rare]

Table adapted from section 5.

Comments:

6.   What is the time span/scale over which the effects of the three most important threats to breed biodiversity are likely to be seen [1 = Less than 1 year; 2 = 1 – 5 years; 3 = 5 – 10 years; 4 = More than 10 years]

Table adapted from section 5.

Comments:

7.   Any comment(s) or observation(s) regarding threats to AnGR in your country/sub-region/region?

8.   Will you be willing to write case studies dealing with threats to AnGR in your country/sub-region/region? If so please provide us with your contact details (Name, telephone, email address etc).

We thank you very much for your time and effort. Just in case of anything you can reach us by email (DAD-Net@fao.org). The findings will be discussed in an electronic conference with DAD-NET subscribers. We would request your active participation in this conference. It is our hope that this process contributes to formulating the best strategies to improve management and conservation of AnGR.

Annex 2.3: Profile of the respondents –2009

	Africa	Asia and the Pacific	Europe	Latin America and the Caribbean	Near East	North America	Total
Extension service provider	10		2	4	2		18
Gene bank/conservation unit	12	4	24		2	3	45
Government (e.g. Ministry of Agriculture)	27	5	37	14	2	5	90
Learning institution (e.g. University)	8		31	5	1		45
Livestock keeper	3		1			2	6
Non-governmental organization (NGO)	3	1	10			7	21
Private enterprise/company	3	1	1				5
Regional organization			2				2
Research institution	34		50	12	9		105
Veterinary service provider	7						7
Total	107	11	158	35	16	17	344

Note: some respondents are affiliated to more than one category.

Annex 2.4   Distribution of responses

Table 1: Questionnaire – 2009 Part 1 - Global distribution of responses for economic development, target market, market orientation, agro-ecological zone and livestock production system by FAO region

	Africa	Asia and the Pacific	Europe	Latin America and the Caribbean	Near East	North America	Total
Economic development							
Low-income	215						215
Lower-middle-income	65	13	36	45	45		204
Upper-middle-income	25		55	105			185
High-income		15	452	10		65	542
Total	305	28	543	160	45	65	1146
Target market							
Local	120	10	210	60	5	15	420
National	100	18	171	60	35	35	419
Regional	65		84	25	5	10	189
International	20		78	15		5	118
Total	305	28	543	160	45	65	1146
Market orientation							
Fully commercial	45	5	191	65		30	336
Commercial & subsistence	160	13	222	60	35	25	515
Purely subsistence	80	5	95	30	5		215
Total	*285*	*23*	*508*	*155*	*40*	*55*	*1066*

Agro-ecological zone

Arid/Semi arid	115	5	199	35	10	25	389
Highland/Temperate	60	8	225	90	5	25	413
Humid/Subhumid	130	15	119	35	30	15	344
Total	*305*	*28*	*543*	*160*	*45*	*65*	*1146*

Livestock production system

Agroforestry-livestock	30		40	10			80
Agropastoralist	25		44	20	5	5	99
Crop-livestock	120	10	184	65	10	15	404
Pastoralist	50		115	5			170
Ranching/other private	20		88	30	5	30	173
Industrial	25	8	37	20		10	100
Backyard/Scavenger	35	10	35	10	25	5	120
Total	*305*	*28*	*543*	*160*	*45*	*65*	*1146*

Table 2: Questionnaire – 2009 Part 2 - Global distribution of responses for species and species group by FAO region

	Africa	Asia and the Pacific	Europe	Latin America and the Caribbean	Near East	North America	Total
Species							
Buffalo	6	2	15	9			32
Cattle	84	2	134	45	21	26	312
Goat	21	2	81	18	18		140
Sheep	36		86	30	3	11	166
Pig	45		73	35	9	9	171
Chicken	60	1	109	27	16	13	226
Duck	6	2	9	9	10		36
Goose			17		1		18
Turkey	3		6	6	3	3	21
Dromedary	3						3
Alpaca				3	3		6
Guanaco			3				3
Llama			3	3			6
Vicuna			3	3			6
Ass	5		21	6	3		35
Horse	20		74	27	3		124
Total	**289**	**9**	**634**	**221**	**90**	**62**	**1305**
Species group							
Large ruminants	90	4	149	54	21	26	344
Small ruminants	57	2	167	48	21	11	306
Pigs	45		73	35	9	9	171
Poultry	69	3	141	42	30	16	301
Camelids	3		9	9	3		24
Equines	25		95	33	6		159
Total	**289**	**9**	**634**	**221**	**90**	**62**	**1305**

Annex 2.5   Distribution of responses for threats, by livestock production systems and AEZ
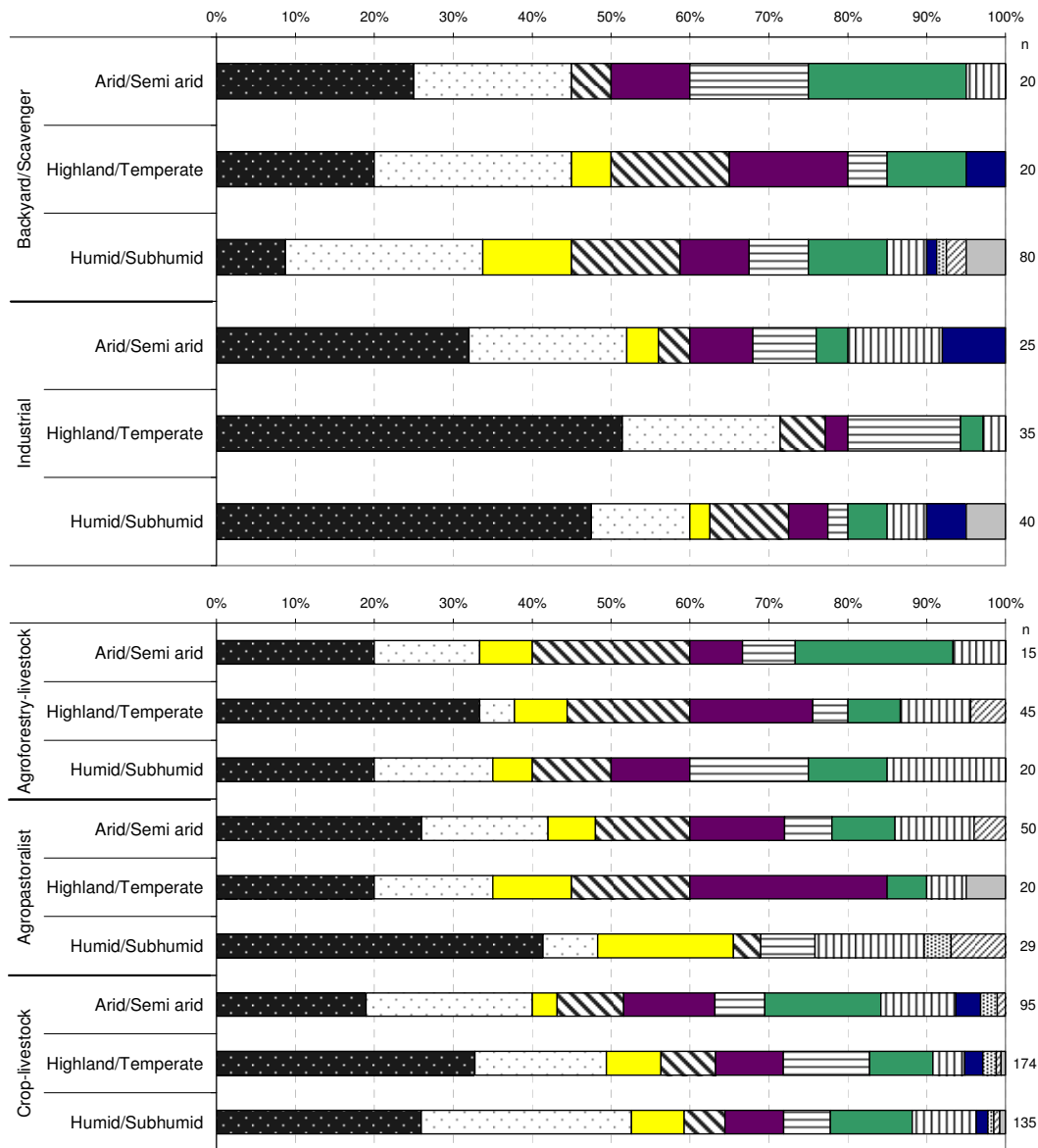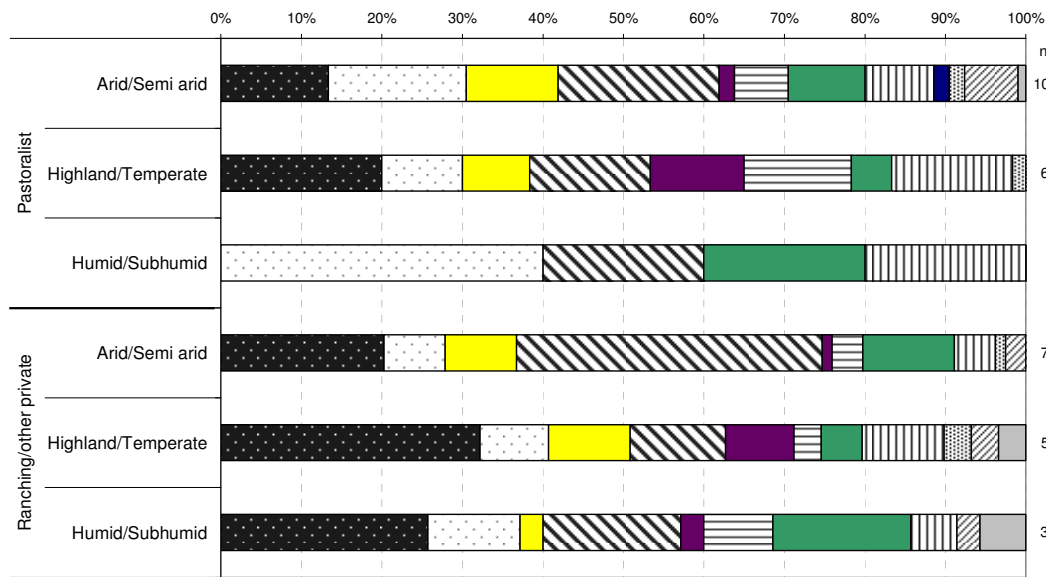
Source: 2009 questionnaire (1066 threats).

Legend:
- ■ Economic and market drivers
- □ Poor livestock sector policies
- ■ Socio-political instability
- ◧ Lack of functional institutions
- ■ Poor conservation strategies
- ▤ Disease and disease control
- ■ Loss of labour force
- ◫ Loss of production environment
- ■ Replacement of breed functions
- ▦ Climate change
- ▨ Natural disasters
- ■ Use of reproductive technologies

Annex 2.6 Distribution of responses for threats, by market orientation within agro-ecologica zones
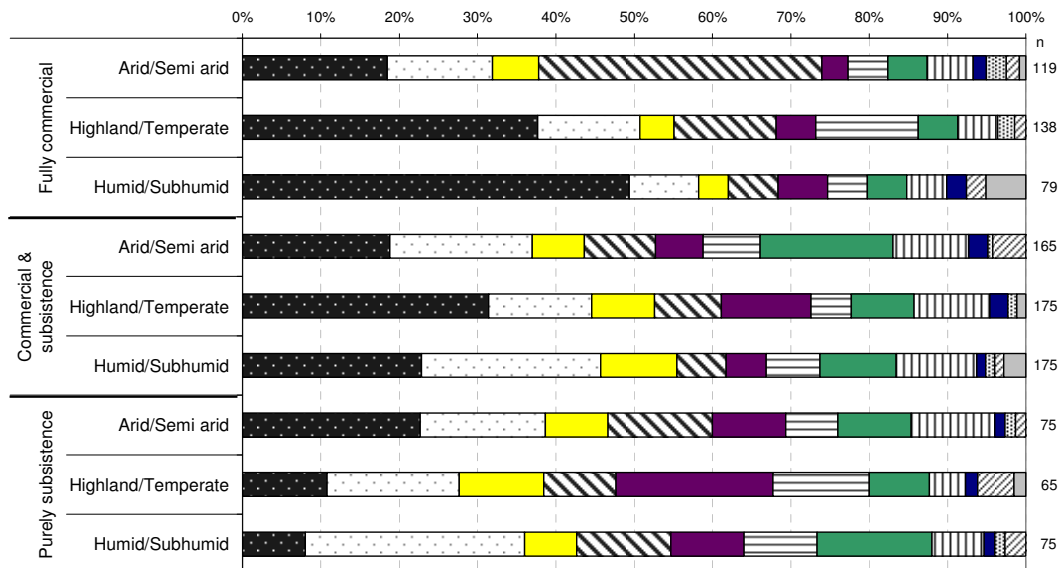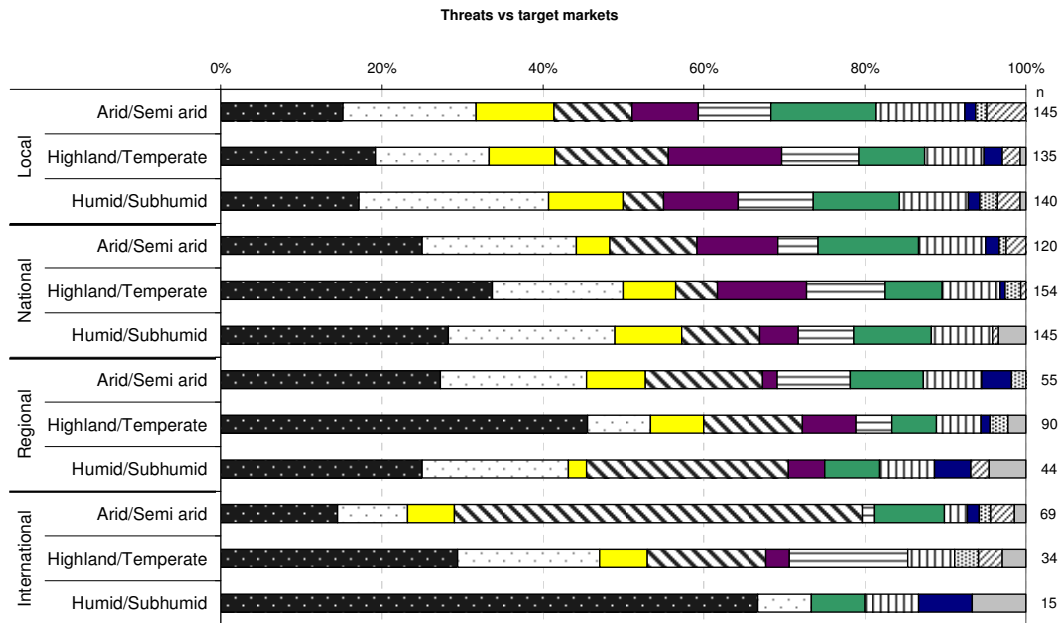
Threats vs target markets

Source: 2009 questionnaire (1066 threats).

- Economic and market drivers
- Poor livestock sector policies
- Socio-political instability
- Lack of functional institutions
- Poor conservation strategies
- Disease and disease control
- Loss of labour force
- Loss of production environment
- Replacement of breed functions
- Climate change
- Natural disasters
- Use of reproductive technologies

ANNEX 3:   DAD-IS/DAGRIS SURVEY – 2009: DISTRIBUTION OF RESPONSES

Table 1: DAD-IS/DAGRIS survey - Global distribution of responses for species, species group transboundary status and risk status by FAO region

	Africa	Asia and the Pacific	Europe	Latin America and the Caribbean	Near East	North America	Total
Species							
Buffalo		13	5				18
Cattle	136	27	307	14		9	493
Goat	5	21	64	2		5	97
Sheep	25	17	246	2		6	296
Pig	11	7	167			8	193
Chicken	1	25	612	8	6	17	669
Duck		3	49				52
Goose	2		60				62
Guinea fowl	6		1				7
Muscovy duck	1						1
Ostrich	11						11
Partridge	1						1
Pigeon	3		13				16
Quail			4				4
Turkey			32			18	50
Rabbit			36				36
Ass			21			2	23
Horse		6	144	3		11	164
Total	*202*	*119*	*1761*	*29*	*6*	*76*	*2193*
Species group							
Large ruminants	136	40	312	14		9	511
Small ruminants	30	38	310	4		11	393
Pigs	11	7	167			8	193
Poultry	25	28	771	8	6	35	873
Rabbits			36				36
Equines		6	165	3		13	187
Total	*202*	*119*	*1761*	*29*	*6*	*76*	*2193*
Transboundary status							
international	5	1	107	11		32	156
local	120	115	1527	16	6	33	1817
regional	77	3	127	2		11	220
Total	*202*	*119*	*1761*	*29*	*6*	*76*	*2193*
Risk status							
Critical	53	16	371	2		53	495
Critical-maintained	4	43	96	6			149
Endangered	121	30	441	18	6	23	639
Endangered-maintained	1	24	576	1			602
Extinct	23	6	277	2			308
Total	*202*	*119*	*1761*	*29*	*6*	*76*	*2193*

ANNEX 4:   E-CONFERENCE QUESTIONS

1.   How prevalent are the identified threats to AnGR in your country and region? You may want to comment on the spatial scale, frequency of occurrence, magnitude of impact, future trend, time frame over which the negative effects of the threats become evident, etc.

2.   Does the global overview of threats to AnGR presented in the preliminary findings provide a realistic indication of the prevailing trends?

3.   Do you concur with the findings regarding the threats to AnGR in your region?

4.   Do you agree with the finding that there are no threats to AnGR that are specific to particular agro-ecological zones and livestock production systems?

5.   Are economic and market driven threats the most important as far as reduction in AnGR diversity is concerned?

6.   Should the use of modern reproductive biotechnologies be considered a threat to AnGR diversity?

7.   What could be reasons behind the lack of consensus on the impacts of threats to AnGR?

8.   Is the proposed classification of threats to AnGR logical and comprehensive enough? How useful is this classification in your country or region?