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BREED DIVERSITY IN DRYLAND ECOSYSTEMS

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BREED DIVERSITY IN DRYLAND ECOSYSTEMS[1]

I INTRODUCTION

1. The domestic animals important today for food and agriculture are the result of processes of domestication that have been continuing for almost 12,000 years. As human societies evolved, migrated or extended the area under their control, animals were domesticated and breeds developed to provide for human needs within new environments. The result was the development of genetically distinct breeds as these animal populations responded to two interacting forces: selection pressures imposed by human communities, identifying and making greater use of preferred genetic types amongst the available animals; and the selection pressures imposed by environmental stress factors. The more than 40 domesticated species contribute directly and indirectly to 30 – 40 percent of the total value of agricultural production.

2. Animal genetic diversity allows farmers to select stock or develop new breeds in response to environmental change, threats of disease, new knowledge of human nutrition requirements, changing market conditions and societal needs, all of which are largely unpredictable. What is predictable, however, is the future human demand for food. This demand will be felt most acutely in developing countries, where 85 percent of the increased food demand is expected. Given the above facts, domestic animal diversity is critical for rural food security (FAO/UNEP, 2000).

3. Livestock is an important element in many agro-ecosystems. This is particularly true for arid and semi-arid areas, where extensive grazing frequently is the only means to produce (high-value) agricultural products under the given eco-climatic conditions (Scoones, 1994). Pastoralism and agro-pastoralism are the key agricultural production systems in many drylands. In these systems, animals have become an essential element of the cultural, social and religious life of the people who depend upon them (FAO, 2000), and specific breeds adapted to the needs of the people and to the environmental stressors have been developed. In many countries, livestock waste products are highly important sources of fuel and are widely used for cooking and heating. This is particularly true for dryland systems, and for dryland species such as cattle, camel and yak (FAO, 2000). In sub-Saharan Africa drylands constitute nearly half of the land area, and in some countries pastoralists represent the majority of the population. Nevertheless, most governments of countries with pastoral populations are hesitant to invest in pastoral production systems, pastoralism being regarded as backward oriented with little potential for improvement (Niamir-Fuller, 1999; Rass, 2006). This attitude interlinked with other pressures has led to the situation that pastoralism worldwide is threatened as a livestock production and livelihood system (Blench, 2001). Pressures on pastoralists include increased human population densities, government policies on land tenure leading to the encroachment of cultivation onto rangelands, private ranching and protected areas, failure to develop appropriate livestock and human services, recurrent drought and armed conflict (Niamir-Fuller, 1999; Devendra et al., 2005). Consequently, animal genetic resources kept in these systems are potentially threatened.

4. The objective of this paper is to assess the share and the importance of livestock genetic diversity maintained by dryland ecosystems as compared to the global situation.

[1] FAO presented an earlier version of the paper at the The Future of Drylands Conference, held in Tunis, Tunisia 19 - 21 June 2006. Organized by UNESCO in partnership with several international organizations, the conference was held within the context of the United Nations International Year of Deserts and Desertification (2006) as part of the UN's collective efforts to reach the Millennium Development Goals (see http://www.unesco.org/mab/ecosyst/futureDrylands.shtml). A publication is being prepared by UNESCO. Given the importance of the topic for the Intergovernmental Technical Working Group, a revised version is submitted for its Fourth Session.

II MATERIAL AND METHODS

5. The analysis commenced by selecting countries with drylands to be included. The North America and Europe regions were excluded from the analysis. The countries to be included in the other regions were selected by visual appraisal of the livestock production systems maps published by Thornton et al. (2002). These maps use similar production system categories to those used by Seré and Steinfeld (1996). In addition, FAO country profile maps showing the length of growing period were consulted (http://www.fao.org/countryprofiles). For the purpose of this paper, drylands were defined as lands with a growing period of less than 120 days (FAO, 1993).

6. As a result, the following geographic regions were considered: all countries of the Near East, selected countries in Latin America, Africa and Asia, while the Southwest Pacific, Southeast Asia and the Caribbean were excluded from the analysis. In total 34 countries were included in the analysis with the following regional distribution: Africa (16), Asia (5), Near East (7), and Latin America (6).

7. The assessment of the contribution of drylands to the global supply of animal products and overall production of the share of drylands of the populations of the selected species was based on FAO statistics for the selected countries. The assignment of country-level information from FAO statistics to dryland livestock production systems (Groenewold, 2004) followed the method developed by Seré and Steinfeld (1996) for livestock production systems. Seré and Steinfeld distinguished grassland-based systems (LG2), mixed-rainfed systems (MR), mixed irrigated systems (MI) and landless systems (LL). A further distinction within these three systems is based on their occurrence in temperate zones and tropical highlands (e.g. LGT), humid and subhumid tropics and subtropics, and arid and semi-arid tropics and subtropics. The statistics presented in this paper were calculated for grassland-based systems in semi-arid tropics and subtropics (LGA); and mixed rainfed (MRA) or mixed irrigated systems (MIA) in the arid and semi-arid tropics and subtropics with a considerable proportion of pastureland were included. Human population figures are presented in relation to the resource base (land and livestock numbers). Livestock production and productivity as well as density indicators were also calculated.

8. Assessment of and reporting on the state of livestock genetic diversity and on the state of management of animal genetic resources in general is one element of FAO's Global Strategy for the Management of Farm Animal Genetic Resources. To assess the current situation and encourage country-level actions, FAO coordinated a first country-driven State of the World's AnGR reporting process. FAO also maintains the Domestic Animal Diversity Information System - DAD-IS (http://www.fao.org/dad-is). The information system includes a global inventory of animal genetic resources, containing national data reported by more than 180 countries. It covers more than 30 species used for food and agriculture. In 2005, the databank was updated and further developed based on 169 country reports on management of animal genetic resources received by FAO during the years 2002-2005. The number of within-country breed populations reported to FAO increased to nearly 14 000 for all mammalian and avian species recorded, ecompassing more than 7600 different breeds. However, it has to be noted that even though data has been collected over more than 10 years, there are still big gaps in the information on population sizes and structures.

9. This database was used to assess breed diversity and risk status. The analysis was restricted to mammalian species that are sustained by dry rangelands, namely camelids (Bactrian camel, dromedary, llama and alpaca), cattle and yaks, goats and sheep as well as asses and horses. Breed entries for these species were classified into two categories: breeds that occur in drylands or were developed in drylands, and all other breeds of the species. Once the lists of breeds for the selected countries had been prepared, a number of experts were consulted to assist in the classification of the breeds in the two categories.

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[2] Grassland-based systems are livestock systems in which more than 90 percent of dry matter fed to animals comes from rangelands, pastures, annual forages and purchased feeds and less than 10 percent of the total value of production comes from non-livestock farming activities. Annual stocking rates are less than 10 livestock units per hectare of agricultural land.

III RESULTS AND DISCUSSION

Resource base, production and productivity

10. Table 1 provides an overview of general data such as the human population; the resource base in terms of land; the numbers of cattle, and sheep and goats; major outputs for these species; and several productivity and density indicators. For these parameters, the table presents data for the drylands of the selected regions and compares them to the world totals. Our calculation for selected countries based on the Seré and Steinfeld classification covers 24 % of the Earth's land surface whereas the total land area covered by drylands according to IUCN (http://www.iucn.org/wisp/) stretches over 41%. In terms of area, Asia contains most of the drylands of the world, followed by Africa, the Near East and Latin America. Thirty percent of the world's grazing lands are classified as drylands, which maintain 6% of the world's human population, 9% of the world's cattle and 18% of the world's sheep and goats. Density of the human population per ha of land is, particularly for grazing land, significantly lower than the world's average. However, only 5% of the world's beef meat production, 14% of the sheep and goat meat and 5% of the milk is produced in dryland systems. These figures originate from official governmental statistics reported to FAOSTAT and probably mainly include marketed products. This ignores the important contribution of marketable and non-markteable production to subsistence. Based on those estimates, output per head of animal is 50 – 70% of the world's average depending on the product.

Table 1: General data, production of main products and productivity of dryland systems in selected countries (based on Groenewold, 2004; Seré and Steinfeld, 1996).

Parameters	Africa	Asia	Latin America	Near East	Dry-lands total	World	%
Human population (millions)	120	96	80	67	364	6,135	6
Resource base							
Permanent pasture (million ha)	346	414	72	253	1,085	3,591	30
Arable land (million ha)	32	48	16	17	114	1,474	8
Irrigated land (million ha)	2	14	4	6	26	277	9
Livestock numbers							
cattle (million head)	54	17	29	19	119	1,360	9
dairy cows (million head)	9	7	5	3	24	231	11
sheep and goats (million head)	117	116	22	71	327	1,780	18
Major outputs (million kg)							
Beef meat	963	754.0	1,148	228.0	3,093	57,769	5
Sheep & goat meat	432.0	717	81	417.0	1,647	11,917	14
Dairy milk	3,615	11,690	6,813	3,371	25,489	503,417	5
Other milk	2,329	1,194	30	1,707	5,260	91,828	6
Total milk production	5,944	12,884	6,843	5,078	30,749	595,245	5
Productivity and density indicators							
Beef meat (kg/head)	18	44	40	12	26	42	61
Sheep & goat meat (kg/head)	4	6	4	6	5	7	68
Milk yield/cow (kg)	399	1,650	1,363	1,006	1,041	2,176	48
Ruminant meat/inhabitant (kg)	12	15	15	10	13	11	115
Grazing land/inhabitant (ha)	3	4	1	4	3	1	510
Arable land/inhabitant (ha)	0.3	0.5	0.2	0.3	0.3	0.2	130

11. The importance of drylands becomes more obvious when looking at countries that are classified entirely as drylands, such as Djibouti, Somalia, Eritrea, Sudan, Niger, Mauritania, Benin, Chad, Guinea-Bissau, Guinea and Mali. In East Africa, the highest number of pastoralists reside in Sudan and Ethiopia followed by Somalia. However, while in Somalia with 6 million pastoralists 78% of the total population are pastoralists, in Sudan with 15 million pastoralists only 41% of the total population are pastoralists. In Djibouti the 0.2 million pastoralists make up 81% of the total population (Rass, 2005). The pastoralists in these countries not only own a major proportion of the national herd, but also contribute a significant share to national meat production – 41% for East Africa and 33% in West Africa (Table 2; Rass, 2006). But it needs to be noted that sub-Saharan Africa is not only home to the greatest share of the world's pastoralists (50 million), but also to the majority of the world's extremely poor pastoralists (54%). Poverty incidence among pastoralists within the different countries in sub-Saharan Africa ranges from 25 to 55 % (Rass, 2006).

Table 2: Numbers and percentages of livestock in the Horn of Africa (Rass, 2005)

	Cattle			Goat			Sheep		
	Pastoral	**All**	**%**	**Pastoral**	**All**	**%**	**Pastoral**	**All**	**%**
Djibouti	240,743	257,369	94	486,412	504,694	96	455,864	464,705	98
Eritrea	1,130,000	2,127,147	53	761,666	1,689,049	45	1,048,582	2,132,409	49
Ethiopia	3,326,658	33,073,908	10	1,307,186	8,596,816	15	1,021,758	10,946,723	9
Kenya	2,877,269	11,691,030	25	4,406,668	9,981,412	44	3,089,806	7,907,252	39
Somalia	4,353,026	5,105,792	85	11,074,675	12,062,375	92	12,866,649	13,682,065	94
Sudan	18,098,422	37,066,916	49	18,322,142	38,550,853	48	22,231,217	46,072,048	48
Uganda	257,249	5,964,001	4	108,387	6,390,937	2	38,272	1,079,425	4

Breed diversity

12. As expected, livestock diversity in the Near East is mostly maintained in the drylands, 90% of all the region's breeds are bred and kept in the drylands (Table 3). In Africa, 56% of its total diversity is adapted to drylands, 42% in Asia and only 19% in Latin America. On average, 46% of the breeds in the four regions are adapted to drylands.

13. The distribution of some domesticated species is completely or mainly restricted to specific parts of the drylands. Camelids are hardly found outside of drylands, with the species differing in their adaptation to altitude and climatic zones. In Asia, the camel population is currently in stark decline, although it is stable in Africa. In Africa, Somalia, Sudan, Mauritania and Kenya have the largest populations, while India and Pakistan account for most Asian camels. The two-humped Bactrian camel is confined largely to Central and East Asia, with Mongolia and China having the largest populations. The largest number of camel breeds is found in Africa. Yaks are specialized to very harsh high high-altitude environments in the Asian drylands and are only raised in these areas. At lower altitudes, they are either crossed with or replaced by cattle; in many parts of the Himalaya, yak crosses with cattle are extremely important. The total number of yaks is estimated at 14 million, of which 13 million are found in China and 0.5 million in Mongolia. Small numbers are also present in the Russian Federation, Nepal, Bhutan, Afghanistan, Pakistan, Kyrgyzstan and India. The unique genetics of the yak, which enable it to tolerate the low atmospheric oxygen levels of the Asian highlands, enable human communities to live in these otherwise inhospitable ecosystems by supplying most of their daily needs (FAO/UNEP, 2000). Yaks produce fat- and protein-rich milk and are used as a beast of burden. In addition to contributing to agricultural production, the yak is valued as a cultural, religious, and social asset.

14. More than 70% of the breeds of asses reported are adapted to drylands. The number of asses is high in the Near East and in Asia, where they are used as work and pack animals. The country with the largest population is China, where Mao Zedong popularized the animal to decrease the drudgery faced by rural women. It is believed that fewer breeds have been developed than in other species, but it is likely that many breeds have never been recorded, as asses have not yet been covered by research. As in the case of yaks, in more favourable agro-ecological conditions, horses or their crosses with asses are often preferred and a smaller number of ass breeds are found. Nevertheless, 30% of the horse breeds are also particularly adapted to drylands. Around half of sheep and goat breeds are particularly adapted to drylands, while this is the case for a third of cattle breeds.

Table 3. Number of local breeds (including extinct breeds) reported per region

Species	Africa		Asia		Latin America		Near East		Total	
	Σ	dryland	Σ	dryland	Σ	dryland	Σ	dryland	Σ	dryland
Cattle	176	76	257	55	148	17	44	34	625	182
Yak	0	0	26	26	0	0	0	0	26	26
Goat	86	45	184	81	26	17	34	31	330	174
Sheep	114	68	276	149	47	12	51	46	488	275
Ass	18	17	39	27	21	7	17	17	95	68
Horse	42	17	142	43	65	4	14	14	263	78
Alpaca	1	1	0	0	2	1	0	0	3	2
Bactrian Camel	0	0	8	7	0	0	0	0	8	7
Dromedary	44	43	13	13	0	0	23	23	80	79
Llama	0	0	0	0	3	2	0	0	3	2
Σ	**481**	**267**	**945**	**401**	**312**	**60**	**183**	**165**	**1921**	**893**

(selected countries)

15. Due to the mobile lifestyle of many livestock keepers in the drylands, the same breed often occurs in more than one country. These "transboundary" breeds were classified as regional transboundary breeds if they are restricted to a single region, or as international transboundary breeds if their distribution crosses regional borders.

16. Sixty percent of the world's regional transboundary breeds can be found in the drylands where mobile livestock keeping is a very old management strategy. The proportion differs greatly between species ranging from 41% in horses, and 48% in cattle to 70-100% of the other species listed in Table 4. Probably an even larger proportion of national breed populations are in fact genetically connected, and there has always been exchange of breeding material across country borders. Interestingly, no regional transboundary breeds have been reported for yaks or Bactrian camels.

17. In Africa and Asia, dryland breeds represent a relatively high proportion of all regional transboundary breeds, – 69% and 58% respectively; while in Latin America the percentage is much smaller (27%). A surprisingly small number of regional transboundary breeds (4 breeds of sheep) were counted in the Near East. This is probably due to the fact that a lot of the region's transboundary breeds are also found in neighbouring countries of Africa and Asia, which leads to them being classified as international transboundary breeds. It has to be kept in mind that political borders do not necessarily correspond to agro-ecosystems, and countries are of different size and resource endowment. In India for example, transhumance movements are possible largely within the subcontinent, whereas in smaller African countries, traditional seasonal livestock movements cross modern state boundaries (Niamir-Fuller, 1999).

Table 4. Number of regional transboundary breeds (including extinct breeds) reported per region

Species	Africa		Asia		Latin America		Near East		Total	
	Σ	dryland	Σ	dryland	Σ	dryland	Σ	dryland	Σ	dryland
Cattle	36	21	19	7	8	2	0	0	63	30
Goat	15	14	11	8	2	0	0	0	28	22
Sheep	27	21	13	7	2	0	4	3	46	31
Ass	4	3	3	3	1	0	0	0	8	6
Horse	7	2	10	7	5	0	0	0	22	9
Alpaca	0	0	0	0	2	2	0	0	2	2
Dromedary	2	2	1	1	0	0	0	0	3	3
Llama	0	0	0	0	2	2	0	0	2	2
Σ	**91**	**63**	**57**	**33**	**22**	**6**	**4**	**3**	**174**	**105**

(selected countries)

18. Twenty-three percent of the international breeds are adapted to drylands (Table 5). This is a surprisingly high proportion, which results from the fact that there has always been exchange and trading across Africa, the Near East and Asia. However today, commercial trade in the international transboundary dryland breeds is probably much less common than in the international breeds of temperate origin.

Table 5. Number of international transboundary breeds (including extinct breeds) reported per species

Species	Number of breeds within species	
	Σ	drylands
Cattle	113	17
Goat	40	18
Sheep	100	21
Ass	6	5
Horse	66	11
Bactrian Camel	2	2
Dromedary	2	2
Σ	**329**	**76**

19. Nevertheless, some international dryland breeds are well known and commercially marketed in large parts of the world. The Boran cattle breed was developed by Borana pastoralists in Ethiopia and improved by ranchers in Kenya (Valle Zárate *et al*. 2006). The Boran is an East African Shorthorned Zebu type, raised primarily for meat production, and shows high resistance to heat, ticks, and eye diseases. It has been reported from 11 countries: nine in East, Central and Southern Africa; Australia and Mexico.

20. The Karakul sheep is probably the oldest breed of domesticated sheep. It is native to Central Asia and named after a village called Karakul located in the valley of the Amu Darja River in the former emirate of Bukhara, in today's Uzbekistan. This region is one of high altitude with scant desert vegetation and a limited water supply. Archaeological evidence indicates the existence of the Persian lambskin as early as 1400 B.C. and carvings of a distinct Karakul type have been found on ancient Babylonian temples. Although known as the "fur" sheep, the Karakul provides more than the silky pelts of the young lambs. They are also a source of milk, meat, tallow, and wool, a strong fibre which

was felted into fabric or woven into carpeting (http://www.ansi.okstate.edu/breeds/sheep/). The Karakul is nowadays found in substantial numbers in southern Africa, and has also spread to India, Australia, Brazil, Europe and the USA.

21. The Awassi, a dairy sheep breed of the Near Eastern Fat-tailed type, has spread to 15 countries in southern and eastern Europe, Central Asia, Australia and the Middle East. In the course of several thousand years, the Awassi had become fully adapted to the harsh conditions of its extensive breeding area in the semi-arid or arid regions of southwest Asia. It evolved as a nomadic sheep breed through centuries of natural and selective breeding to become the highest milk producing breed in the Middle East (FAO, 1985).

22. The Arabian horse is the most successful among the world's horses. It has had unique influence on horse breeds throughout Europe and has spread to 52 countries.

23. The Damascus (also called Shami) goat has a more limited distribution. It originates from Syria and is raised primarily for milk production. It has recently been improved in Cyprus and has gained international recognition as an outstanding dairy breed for tropical and sub-tropical regions. While population numbers have remained small, the breed has spread around the Mediterranean basin (Alandia Robles *et al*., 2006).

Risk status of breeds in drylands

24. To assess the threat of erosion, the risk status of the dryland breeds was examined and compared to the global situation (Table 6). Breeds were classified as at risk when the total number of breeding females was equal or lower to 1 000 or the total number of breeding males was less than or equal to 20. It was found that the proportion of dryland breeds at risk is highest in Africa (44%), followed by the Near East (33%) and Asia (19%). In Latin America only 2% of the dryland breed diversity is classified as at risk. In comparison to the global situation, the proportion of dryland breeds at risk is higher than for non-dryland breeds in Africa, and lower in Asia, Latin America and the Near East. In total, however, only 4% of the world's breeds classified as at risk are found in the drylands. So far only three percent of the dryland breeds have been reported as extinct. This is much lower than the world's total of 11%.

Table 6. Risk status of dryland *versus* all mammalian breeds reported per region

Risk status	Local and regional transboundary breeds								Internat. Breeds		Total breeds	
	Africa		Asia		Latin America		Near East				Dry-lands total	World
	Σ	dry-land	Σ	dry-land	Σ	dry-land	Σ	dry-land	Σ	dry-land	Σ	Σ
at risk	43	19	80	15	43	1	6	2	29	2	39	881
extinct	35	10	45	12	21	5	5	3	1	1	31	643
not at risk	187	65	776	228	81	19	85	62	312	59	433	2135
unknown	384	173	469	147	304	35	107	98	58	14	467	1940
Σ	**649**	**267**	**1370**	**402**	**449**	**60**	**203**	**165**	**400**	**76**	**970**	**5599**

(selected countries)

25. Table 7 summarizes the status of dryland *versus* that of all breeds by species. A quarter of the breeds reported for the species included in this analysis are found in the drylands of the world. Only a small percentage of these breeds are classified as at risk (7%).

26. These figures have to be treated with caution, as for more than half of all reported dryland breeds no risk status could be defined due to missing population data. This lack of population data is even more pronounced in camelids and asses. The proportion of missing data, particularly on the size and structure of dryland breed populations, is much higher than for breeds found in the other agro-ecological zones. In Africa, 65% of the dryland breeds could not be assigned to any risk category, this

number was close to 60% in the Near East and Latin America. In Asia, data were more complete, for only 37% of the breeds were information unavailable. The lack of information for dryland breeds can be explained by the mobile lifestyle of many people living in the drylands, which means that they are less linked to the organizational structures of their countries. Also, in many countries policies tend to discriminate against pastoralists, and their breeds may be less likey to be characterized or included in national inventories.

Table 7. Risk status of breeds by species

Species	at risk		extinct		not at risk		unknown		World	
	Σ	dry-land	Σ	dry-land	Σ	dry-land	Σ	dry-land	Σ	dry-land
Cattle	210	6	209	17	499	120	393	92	1311	235
Yak	0	0	0	0	18	18	9	9	27	27
Goat	84	6	19	2	306	113	209	95	618	216
Sheep	179	13	180	11	633	172	417	141	1409	337
Ass	27	5	6	2	34	18	95	54	162	79
Horse	181	10	87	1	246	39	272	50	786	100
Alpaca	0	0	0	0	5	3	1	1	6	4
Bactrian Camel	2	2	0	0	7	6	3	1	12	9
Dromedary	4	4	0	0	33	32	51	48	88	84
Llama	0	0	0	0	5	4	0	0	5	4
Σ	**687**	**46**	**501**	**33**	**1786**	**525**	**1450**	**491**	**4424**	**1095**

IV CONCLUSIONS

27. Human settlement would not be possible in many drylands of the world without well adapted livestock breeds. On the other hand, livestock production is also associated with dryland degradation through overgrazing. Land degradation may be evident around permanent settlements and water points where livestock mobility is reduced, it is much less in open rangelands where mobility is unrestricted. Where mobility continues unhampered, it has resulted in biodiversity conservation and sustainable land management. Where it is constrained it has led to serious over-grazing and land degradation (http://www.iucn.org/wisp/drylands.html).

28. A quarter of the world's livestock diversity has been developed in and is adapted to drylands. A surprisingly high proportion of this livestock diversity consists of regional and international transboundary breeds. Exchange of breeding stocks particularly of dryland breeds among countries and regions is very important and should be supported by appropriate policy and legal frameworks, inluding facilitation of transhumance movements.

29. Erosion of the livestock genetic diversity of the drylands currently seems to be lower than for other production systems. The reasons are that in these harsh environments people depend more on adapted breeds. In addition, government policies directly or indirectly promoting high-input exotic breeds do not reach communities in drylands to the same degree as in more intensive production systems, which results in a relatively favourable situation for breed diversity. However, the related lack of supportive policies, institutions and services may result in a reversal of this situation as the livelihoods of many mobile livestock keepers have been deteriorating in recent decades leading to changes in production strategies and out-migration to more favourable agro-ecological conditions or to urban areas (Lokhit Pashu-Palak Sansthan, 2005).

30. The data quality related to livestock genetic diversity is much lower for drylands than for other production systems. Thus, it is probable that the number of dryland breeds is underestimated as some breeds may have never been officially reported. This might particularly be the case for goats, asses and

camelids, but also for camels (SEVA, 2005). Policy-makers are faced with the challenge of better connecting pastoral communities to services and organizational structures, which would enable better data collection. This would also foster better recognition of the values and diverse roles of dryland livestock. To date, dry grassland based systems have mainly been associated with low productivity, a perception arising from the fact that productivity in terms of output per animal is indeed much lower than the world average. This evaluation, however, neglects the fact that the production systems are characterized by very low levels of external inputs. Thus, if productivity was defined in terms of unit output per unit input, it might be even higher for the drylands than for other more intensive production systems.

31. In particular, local breeds, notably those that have been developed in harsh environments in developing countries, have not been sufficiently characterized. In the case of their extinction, the value lost to humankind is not known. The lack of information hinders proper decision-making with respect to what to conserve and how to allocate the limited funds available for conservation. A certain loss of local breeds will be inevitable and acceptable given the current dynamics in production systems, and the limited availability of resources for conservation in the public sector.

32. However, it is certainly time for action to safeguard of the world's animal genetic resources for food and agriculture, in particular those with specific adaptive traits, many of which are found in the drylands. Animal genetic diversity is mankind's common heritage and contributes to food security at present and will help secure future food security by allowing the supply of a wide range of products under diverse environmental conditions.

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