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ANIMAL GENETIC RESOURCES IN AFRICA[1]

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SUMMARY

This paper reviews the status of farm animal and avian genetic resources in Africa based mainly on the FAO database up to 1999 and according to FAO definitions. The great ecological and climatic variations in Africa have helped creating considerable diversity among and within animal populations. There are 773 breeds of major mammalian and 131 of major avian species in the continent. Breed risk-of-extinction rates are estimated at 10% and 16% for mammalian and avian species, respectively; lower than the corresponding world figures of 25% and 52%. These figures are discrepant with some other estimates in the literature and should be considered with caution until population-size data are scrutinized for accuracy and completeness. Serious efforts are being made to develop programs to better manage animal genetic resources in Africa. The paper emphasizes the need to standardize the definition of breed and harmonize surveying methods for animal genetic resources and to properly characterize the breeds and their production environments.

Keywords: Africa, animal genetic resources, risk, endangered, extinction, breeds, livestock

INTRODUCTION

Africa, the second largest continent after Asia, extends from the Mediterranean in the north to the Atlantic and Indian Ocean in the south and from the Red Sea and Indian ocean in the east to the Atlantic ocean in west. Topography ranges from depressions like the Great Rift Valley in the east to plains such as the north of the Nile valley to plateaus such as the Ethiopian Plateau, deserts such as the Great Sahara to mountains such as the Atlas mountains in the north west and Kilimanjaro in the east of the continent. The climates range from Mediterranean to arid, dry savannah and humid equatorial. In many African highlands the high altitude modifies the weather. This great variety of ecology, climate and the many environmental stresses, e.g. the considerable number of endemic diseases and the frequent famines, have helped moulding a great genetic diversity in animals. Furthermore, human population in Africa is among the fastest growing in the world and there is a challenging task to increase agricultural output to meet the demand. This is made all the more challenging for animal production due to the fact that much of the land in Africa is not readily suitable for cropping, *viz.* the desert and their fringes, and only livestock may be profitable in such production environments.

Animal husbandry has been practised in Africa for over 5 000 years. Despite the domestication of most major species in the Near East or Asia, the continual movement of peoples into Africa through the Isthmus of Suez, from the Arabian peninsula and later on from Iberia, have all contributed to the considerable genetic diversity in evidence today. Starting in the eighth centuries the Arabs introduced large numbers of humped cattle to the continent. Despite that, the proportional livestock contribution to food supply in Africa is less than the world average and declining. Calories from animal products in Africa represented 8% of total intake in 1980, which declined to 7% in 1992 (Qureshi, 1996). Corresponding world figures are 16% and 16%, respectively. The corresponding figures for protein intake are 23%, 21%, 34% and 35%.

IMPORTANCE OF LIVESTOCK IN AFRICA

Table 1 shows numbers of animals in different livestock species in African countries, table 2 these populations for different continents and table 3 the relative share of Africa in the total word population. The continent has got large numbers of livestock especially camels (76% of the world population), asses (34%), cattle (17%) and goats (29%). These are species that particularly suit the prevailing production environments in the continent.

In Africa, livestock plays a very significant role in the economies of most its countries. Over 30% of national gross agricultural product in the continent is contributed by livestock, ranging from 5% for Equatorial Guinea to 87% for Djibouti (table 4). Even with such relatively large contribution of the livestock to African economies, this contribution is thought to be underestimated, for livestock contribution is difficult to quantify (and often neglected) in products like manure, work, the value of livestock as

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financial security element and other social functions that are all particularly important in the African context.

Table 1. Numbers of livestock in Africa, 1999 000

Country	Ass	Buf	Camel	Cattle	Goats	Horse	Mule	Pig	Sheep	Chick.[1]	Duck	Geese	Turk.
Africa	15000	3180	14499	223343	205639	4863	1352	27017	240342	1142	16000	12000	7000
Algeria	200		150	1650	3400	55	70	6	18200	105	0	0	0
Angola	5			3900	2000	1		800	336	7			
Benin	1			1345	1087	6		470	634	29			
Botswana	235			2380	1835	33	3	7	250	4			
Burkina Faso	475		14	4550	7950	25		590	6350	21			
Burundi				329	594			61	165	4			
Cameroon	36			5900	3850	17		1430	3880	25			
Cape Verde	14			22	112	0	2	636	9	0			
Cent. Afr. R	0			2992	2350			622	201	4	0		
Chad	285		700	5582	4968	230		23	2432	5			
Comoros	5			50	129				20	0			
Congo, D R	0			900	4500	0		1100	930	21			
Congo, R				75	285	0		45	115	2			
Côte d'Ivoire				1330	1070			275	1370	29			
Djibouti	9		66	269	511				463				
Egypt	3000	3180	116	3150	3261	46	1	29	4400	87	9000	9000	2000
Eq. Guinea				5	8			5	36	0	0		
Eritrea			75	1550	1700				1570	5			
Ethiopia	5200		1050	35095	16950	2750	630	25	22000	55			
Gabon				35	90			212	195	3			
Gambia	34			360	265	17		14	190	1			
Ghana	13			1273	2739	2		352	2516	17			
Guinea	2			2368	864	3		54	687	9			
Guinea-Biss.	5			520	315	2		340	280	1			
Kenya			830	13392	7600	2		110	5800	30			
Lesotho	152			510	560	98	1	63	720	2			
Liberia				36	220			120	210	4	0		
Lib. Arab Jam.	29		70	142	2200	45	0		6400	25			
Madagascar	0			10353	1410	0		1700	790	18	3000	3000	2000
Malawi	2			750	1260	0		230	110	15			
Mali	652		292	6058	8525	136		65	5975	25			
Mauritania	155		1185	1395	4133	20			6200	4			
Mauritius	0	0		27	93	0	0	20	7	4	0	0	0
Morocco	980		36	2560	5114	150	524	8	16576	100			
Mozambique	23			1310	390			178	124	27	1000		
Namibia	68			2000	1700	52	6	14	2100	2			
Niger	530		404	2174	6469	94		39	4312	20			
Nigeria	1000		18	19850	24300	204		12400	20500	126			
Rwanda				726	634	0		160	290	1	0	0	
Réunion	0			27	38	0	0	89	2	11	0	0	0
Saint Helena	0			1	1	0		1	1	0			
Sao Tome & Prin.	0			4	5	0	0	2	3	0	0		0
Senegal	380		8	2955	3595	508		330	4300	45			
Seychelles				1	5			18		1	0		
Sierra Leone				400	190			52	350	6	0		
Somalia	19		6000	5000	12000	1	18	4	13000	3			
South Africa	210			13565	6457	258	14	1531	28680	60	0	0	0
Sudan	730		3150	35000	37500	26	1		42500	41			

continued

Continued

Country	Ass	Buffa.	Camel	Cattle	Goats	Horse	Mule	Pig	Sheep	Chick.	Duck	Geese	Turk.
Swaziland	15			652	438	1	0	31	26	1			
Tanzania, U R	179			14350	9900			345	4150	28	2000		
Togo	3			223	1110	2		850	740	8			
Tunisia	230		231	780	1300	56	81	6	6600	37			3000
Uganda	18			5700	3650			960	1970	23			
Western Sahara	1		104		170				32				
Zambia	2			2273	1069			324	120	28			
Zimbabwe	106			5500	2770	26	1	272	525	15	0		0

[1] In millions

Table 2. Animal stock numbers by continent, 1999 000

Species/Continent	Ass	Buffalo	Camel	Cattle	Goats	Horse
Mamalian						
World	43479	158627	19130	1338201	709934	61095
Africa	15000	3180	14499	223343	205639	4863
Asia	19848	153527	4620	464910	446626	17406
Caribbean	397	5		8889	2631	1473
C. America	3302			40563	8968	7171
Europe	798	214	11	150554	17953	7457
N. America	449	5	0	120392	4060	8162
Oceania	9	0		36340	716	382
S. America	4072	1701		302097	25972	15652

Species/ Continent	Other cam.	Pig	Chick.	Duck	Geese	Sheep	Turkey
Avian							
World	6047	912708	14139000	83000	219000	1068669	244000
Africa		27017	1142000	16000	12000	240342	7000
Asia		527062	7081000	720000	193000	412608	13000
Caribbean		4257	101000	0	0	755	0
C. America		16680	511000	8000		6479	4000
Europe		206510	1772000	65000	13000	154256	116000
N. America	0	78866	1966000	8000	0	8672	92000
Oceania		5263	107000	1000	0	165718	1000
S. America	6047	51311	1560000	12000	0	80594	12000

Table 3. Africa share of breeds and of population

Species	Africa breed share	Africa population share	Index[1]
Ass	0.27	0.34	0.78
Buffalo	0.10	0.02	5.22
Cattle	0.23	0.17	1.40
Dromedary	0.62	0.76	0.81
Goat	0.22	0.29	0.75
Horse	0.09	0.08	1.08
Pig	0.04	0.03	1.49
Sheep	0.16	0.22	0.70
Africa livestock (mammals)	0.17	0.17	0.99
Chicken	0.10	0.08	1.25
Duck (domestic)	013.	0.02	6.79
Goose (domestic)	0.08	0.05	1.38
Turkey	0.18	0.03	6.15

[1] breed share / population share

Table 4. Contribution of livestock to the gross national agricultural product (GDP) in African countries. 1995

Country	Livestock contribution, 1000$	Ratio to Agric. GDP	Country	Livestock contribution 1000$	Ratio to Agric. GDP
Algeria	1,438,724	0.52	Mauritius	37,010	0.25
Angola	265,464	0.36	Morocco	1,365,769	0.40
Botswana	142,076	0.89	Mozambique	177,725	0.20
Burundi	60,862	0.09	Namibia	285,881	0.86
Cameroon	410,495	0.25	Niger	318,928	0.35
Cape Verde	15,931	0.71	Nigeria	1,885,528	0.13
Cent Afr Rep	166,712	0.40	Guinea-Bissau	31,778	0.25
Chad	315,574	0.38	Eritrea	71,623	0.50
Comoro	5,416	0.14	Zimbabwe	364,625	0.33
Congo, Rep	30,688	0.19	Reunion	45,309	0.44
Benin	119,881	0.12	Rwanda	72,500	0.14
Egypt	2,351,696	0.24	Sao Tome Prn	1,203	0.11
Eq Guinea	1,032	0.05	Senegal	321,216	0.32
Djibouti	27,247	0.87	Seychelles	5,111	0.67
Gabon	37,273	0.30	Sierra Leone	38,122	0.15
Gambia	15,228	0.20	South Africa	3,288,291	0.50
Ghana	215,452	0.10	Sudan	2,179,311	0.59
Guinea	76,507	0.12	Swaziland	59,440	0.39
Cote D'ivoire	205,032	0.08	Tanzania	909,879	0.30
Kenya	1,480,054	0.50	Togo	65,358	0.18
Lesotho	75,120	0.73	Tunisia	542,793	0.37
Libya	209,215	0.40	Uganda	525,880	0.18
Madagascar	650,132	0.35	Burkina Faso	302,713	0.32
Malawi	96,895	0.10	Ethiopia	1,472,278	0.33
Mali	575,270	0.44	Congo, Dem R	332,594	0.11
Mauritania	227,280	0.82	Zambia	203,909	0.40
Africa	25,038,020	0.30			

ANIMAL GENETIC RECOURSES IN AFRICA

The composition of early livestock in Africa was influenced by the constant movement of early herders, such as the migrations of the nomadic peoples across the North African littoral and stocks coming from Asia across the Red Sea through the Horn of Africa and Sinai. The smaller size of the Sahara at early times did not hinder migration as it does at present. This ensured the continual mixing of the gene pool for each species and placed considerable selection pressures on animals to tolerate conditions prevalent in the continent. The demands made on animals and the prevailing production environments have shaped the make-up of the breeds. . For example, West African dwarf sheep and goats and dromedaries have evolved the necessary physiology to cope with hot climates; sheep in the tropics are usually hairy whereas those in colder regions such as the highlands of Ethiopia are woolled.

Breed numbers

Africa has a total of 773 breeds of major mammalian species (ass, buffalo, cattle, dromedary, goat, horse, pig and sheep) and 131 of major avian species (chicken, duck, goose, Guinea fowl, muscovey duck, ostrich, partridge, pigeon and turkey) recorded in the FAO 1999 database (Table 5). Its share of the global number of breeds ranges from 76% for dromedary to 34% for ass to 3% for turkey (Table 3). The ratio between the two percentages indicates the relative breadth of biodiversity within each species; *viz.* within the same size of population the ass has got 22% less breeds in Africa than the world in general (Table 3). While FAO database in 1995 got 158 cattle breeds in Africa (Scherf, 1995), their current list on the Internet shows significant increase to 287. Rege (1999) reported the figure as 145 breeds/strains comprising two Taurine Longhorns, 15 Taurine Shorthorns, 75 zebu, 30 sanga, 8 zenga zebu-sanga), 9 recent derivatives and 6 composites. Rege et al. (1996) reported that in Africa there were at least 150, 125, 90, and 40 breeds/strains of cattle, sheep, goats and dromedary camels, respectively, while Rege and Dester (1998) stated that numbers of breeds/strains of cattle, sheep and goats were 100-150, 50-60 and 45-50, respectively.

There have been efforts made in East Africa to synthesize new breeds from exotic and local breeds, but such synthetics have not spread to any significant extent. Africa has got, probably, the only true meat type goat: Boer. Since most of African breeds have not been exposed to directional selection, the within-breed variation is expected to be higher than other breeds, e.g. European that have been under selection for many generations. Using microsatellite DNA markers, Chenyambuga et al. (2000) reported that East African goat populations showed higher within-breed variability than the standard European breed taken as a reference. The great discrepancy in numbers of breeds reported is due to methods of surveying as much as it is due to the definition of the breed. FAO (1999) defines the breed as "either a sub specific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within species or a group for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity".

Number of breeds at risk

The state of risk[2] of different African breeds varies from one source to another. FAO database (Scherf, 2000) shows that in Africa there are 79 and 21 breeds at risk of extinction in mammalian and avian species, respectively (Tables 5). These estimates represent 10% and 16% of breeds with population size recorded in mammalian and avian species, respectively. Taken at their face values these estimates are lower than their corresponding world estimates of 25% and 52%. In a survey conducted on cattle in sub-Sahara Africa Rege and Tawah (2000) estimated that about 31 % of the cattle breeds/strains are at risk of extinction and 13% have already disappeared. The figures on the African breeds could be less accurate due to the fact that fewer of the African breeds have their populations appropriately classified, measured and recorded, hence the difficulty to assess their risk status. The great disparity between the information in FAO database provided by the countries and the figures reported by Rege and Tawah (1999)

Table 5. Number and status of major livestock species in FAO Global Data Bank for Africa, 1999

Species	U	C	C-M	E	E-M	X	Not at R	Total (incl. X)	Total (excl.X)	R	R rate		X Rate	
											Africa	Global	Africa	Global
Ass	20	0	0	3	0	1	3	27	26	3	0.12	0.22	0.04	0.15
Buffalo	2	2	0	1	0	0	4	9	9	3	0.33	0.13	0.00	0
Cattle	77	9	2	18	1	32	180	319	287	30	0.10	0.24	0.10	0.17
Dromedary	12	1	0	1	0	0	18	32	32	2	0.06	0.06	0.00	0
Goat	53	1	0	3	0	0	67	124	124	4	0.03	0.18	0.00	0.03
Horse	37	6	0	8	0	5	14	70	65	14	0.22	0.40	0.07	0.08
Pig	6	2	0	2	0	1	12	23	22	4	0.18	0.33	0.04	0.23
Sheep	80	10	0	9	0	9	109	217	208	19	0.09	0.20	0.04	0.12
Total	287	31	2	45	1	48	407	821	773	79	0.10	0.25	0.06	0.13
				0										
Chicken	31	0	1	1	1	0	37	71	71	3	0.04	0.52	0	0.04
Duck (domestic)	4	0	0	0	0	0	11	15	15	0	0.00	0.39	0	0.01
Goose (domestic)	2	2	0	0	0	0	1	5	5	2	0.40	0.54	0	0.03
Guinea fowl	5	1	0	4	0	0	9	19	19	5	0.26	0.36	0	0
Muscovy duck	0	0	0	1	0	0	0	1	1	1	1.00	0.44	0	0
Ostrich	1	3	0	1	0	0	0	5	5	4	0.80	0.78	0	0
Partridge	1	1	0	0	0	0	0	2	2	1	0.50	0.09	0	0
Pigeon	1	0	0	3	0	0	3	7	7	3	0.43	0.25	0	0
Turkey	2	1	0	1	0	0	2	6	6	2	0.33	0.34	0	0.03
Total	47	8	1	11	1	0	63	131	131	21	0.16	0.52	0	0.03

[2] FAO (Scherf, 1995) categorizes a breed as **critical** if the total number of breeding females is <100 or the total number of breeding males is ≤ 5; or the overall population is close to, but slightly above 100 and decreasing and the percentage of females being bred pure is < 80%. A breed is categorized as **endangered** if the total number of breeding females is >100 & <1000 or the total number of breeding males is ≤ 20 and >5; or the overall population size is close to, but slightly <100 and increasing and the percentage of females bred pure is above 80%, or the overall population size is close to but slightly above 100 and decreasing and the percentage of females bred pure is <80%.

C: critical X: extinct
E: endangered
M: maintained
R: at risk
U: unknown
brings to attention the need to standardize the definition of the breed and to harmonize methods of surveying animal genetic resources.

Causes of the erosion of diversity in animal genetic resources in Africa. Although table 5 shows that breeds at risk of extinction are relatively less in Africa than the world in general, there are factors particular to Africa that cause concern, most importantly:

- The introduction of exotic breeds
- Desert encroachment around the Sahara and in North Africa
- Natural disasters like the droughts that have occurred more frequently lately and for longer time than before.
- Social strife
- Policy factors that favor exotic breeds and discriminate against locally adapted breeds

Animal Genetic Resources Utilization

In addition to the obvious value of production traits, many African livestock breeds also have a considerable cultural value and are often used for dowries, as a form of barter or for religious purposes. The larger species in particular also serve as the key cash reserve to help cover crop failure. In sub-Sahara, rural households manage risk by using low-yielding but locally adapted breeds of livestock (Williams et al., 1999)

Traditionally two main production systems may be identified in cattle. On the one hand there are the extensive systems essentially based on locally adapted breeds and on the other hand the more intensive systems based mainly on exotic breeds and different grades of their crosses with local breeds.

Cattle extensive production systems

In sub-Saharan Africa traditional production systems may be subdivided into pastoral, agro-pastoral and agricultural, based on relative contribution to household revenue. Pastoral systems are quite important, especially around the desert regions where the levels of nutrition are generally fairly low. These systems are characterized by animals that can withstand severe nutritional and climatic stress and that are tolerant to a number of endemic diseases and long migrations. Livestock used in these systems is strictly local breeds. Typical pastoralist systems are those run by nomadic pastoralists such as the Tuareg and Fulani. Agriculturally based extensive systems require higher levels of productivity and strong animals needed to till the land and to achieve this they usually incorporate better levels of management. Cattle used in these systems are mainly locals but some experimentation took place to incorporate large frame exotic breeds (example: the Friesian crosses with local breeds in Ethiopian highlands). While much of the agro-pastoral and agricultural systems are of subsistence nature, the pastoral systems are usually not and they produce surplus that is marketed domestically and for export.

Cattle intensive production systems

These were developed mainly for dairying based on exotic breeds and their crosses with local breeds. AI is usually practiced in such herds (Philipsson, 2000) and surplus males are disposed of for beef production or slaughtered when they are very young. Males sold live from this system are the main source of indiscriminate crossbreeding.

Production systems of other species

Sheep and goats are usually extensively managed and are used for social and religion occasions. Many trials were made in Africa to cross local sheep, and to less extent goats, with exotic breeds but most of the resulting synthetics or crossing systems were non-sustainable. Pigs are produced mainly under extensive systems. Aside from the hybrid-based commercial poultry production, chicken backyard production based on locally adapted breeds plays a very important role in raising the nutritional level of the population and in income generation. Pigs are generally raised under extensive system with little or no crossbreeding. The pig population goes through severe changes and decimation due to endemic diseases.

Generally speaking, increasing population pressure and limited resources combined with climatic, economic, social and institutional changes are transforming systems for producing crops and livestock from systems based on shifting cultivation to ones that are more intensively managed and based on mixed farming (Williams et al., 1999). Most of these changes will increase the demand on animal products, which will have to be met from sustainable production systems

Characterization

Characterization of domestic animal breeds is necessary to plan the effective utilization of genetic resources, and to identify breeds most at risk in order to determine conservation priorities and approaches. Characterization requires: national inventories of animal genetic resources, ongoing monitoring of these resources, comparative evaluations to increase knowledge of the unique qualities of breeds in order to better utilize these traits and determine appropriate production environments, and comparative molecular descriptions using gene markers and genetic distancing measures to establish the comparative uniqueness of breeds and the genetic diversity they harbor.

In most African countries little information exists on performance, products, and adaptive qualities of most animal species of interest to agriculture. No system exists for monitoring the development of breeds particularly those that are endangered. Characterization should also apply to the production environments under which breeds live and perform. International Livestock Research Institute (ILRI) has accomplished the serious task to genetically characterize major cattle breeds in sub-Saharan Africa (Okomo et al., 1998) and launched similar program for small ruminants.

Conservation

There is very little information on livestock breed conservation, *in situ* or *ex situ*, in Africa. Table 5 shows that there are two endangered cattle breeds and one endangered chicken breed that are maintained.

ACHIEVENMENTS IN ANIMAL GENETIC RESOURCES DEVELOPMENT IN AFRICA

In the past few years awareness has increased about the importance of animal genetic resources and interest aroused to develop them. As a result, most African countries are engaged in some activities related to the management of animal genetic resources. Among the activities that have been started at regional levels are:

- An FAO/UNDP project is currently operational to develop animal genetic resources in 14 SADC[1] countries. The project is concerned with establishing national and regional structures for the better management of animal genetic resources and surveying, characterization and utilization of these resources as well as the characterization of the production environments and training nationals on all these aspects.
- ILRI has genetically characterized major cattle breeds in sub-saharan Africa and is initiating similar activity in small ruminants.
- Similar projects to that in SADC have been prepared for ASARECA[2], for West Africa and for East Africa pending funding.
- A UNDP/Global Envionment Faciltity (GEF)/ILRI/FAO project targeting trypano-tolerant breeds is being considered for a group of West African states.
- A multi-lateral project is being considered to develop surveying guidelines for animal genetic resources with the intention to try these guidelines in some countries before using them in the SADC project mentioned above.

CONCLUSIONS

- FAO database shows that farm animal and avian genetic resources in Africa are less in risk of extinction and lesser number have become extinct than the world in general. However, this should be no reason for complacency. In the first place the risk status is based on population information that needs much verification. In Africa only 65% of mammalian breeds have population information versus 76% for the world. The corresponding figures for avian species are 61% and 80%. Secondly the erosion in animal genetic resources in the developed world was caused in great part by the intensification of animal production systems and emphasizing only few specialized

[1] Southern African Development Community: Angola, Botswana, Congo D R, Lesotho, Malawi, Mauritius, Mozambique, Namibia, S. Africa, Seychelles, Swaziland, Tanzania, Zambia, Zimbabwe

[2] Burundi, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda

breeds, a pathway that is retrospectively looked at as limiting the options for sustainable development especially for future generations.

- Endigenous breeds must be properly surveyed, characterized and life-cycle evaluated for appropriate production environments. Evaluation must also include their adaptive fitness traits.
- A methodology needs to be developed to characterize production environments in order to be able to determine which breeds fit best what environment.
- Biotechnologies should be appropriately used in reproduction and genetic conservation. The misuse of biotechnology has been a cause for genetic erosion in many situations.
- An old animal production practice needs to be revisited: stratification. This will lead to the delineation of high potential (inputs and climate) areas where introduction of exotics could be recommended and other areas where only locally adapted breeds can be productive.

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