




SULTANATE OF OMAN

Second Country Report on the State of Farm Animal Genetic Resources

Ministry of Agriculture and Fisheries
2014

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Foreword

Oman is endowed with its rich biodiversity as it has not only diversified traditional agriculture involving almost all types of animal and crop species but also vast rangelands especially in Dhofar having various pasture species, the source of feeding large number of animals. Oman has wide diversity of animal genetic resources (AnGR) which are indigenous and known to be in the Sultanate since time immemorial. These constitute cattle, sheep and goats, poultry and camels. Interestingly, these animals are so adapted and become very specific and characteristic to different agro-ecological regions of the country that they are called by their names as Dhofari, Sahrawi, and Batinih etc. These are the sources for diet and food in addition to other human use in the country.

Under the leadership of His Majesty Sultan Qaboos, Oman is well aware of the importance of its own animal genetic resources and hence attained the status of constituent member of the Global Plan of Action for food and agriculture through the Royal Decree 10/97 in 1997. Further, Oman has leaped forward to take steps of conservation of its animal genetic resources either individually or globally in collaboration with international organizations/ institutes. It has signed several agreements and passed Royal Decrees and Regulations related to the protection and conservation of both plant and animal genetic resources. In respect of animal genetic resources, there are various activities in the Sultanate, which related to conservation and utilization of large and small ruminants like camels, cattle, sheep and goats, and poultry birds. In the Ministry of Agriculture & Fisheries, four Livestock Research Centers/ Stations located in Rumais, Wadi Quriyat, Jabal Akhdar and Salalah have been established with objectives to conserve indigenous strains of small ruminants such as sheep and goats, Batinh and Dhofari cattle and Dhofari poultry and to improve them. Animal improvement programs are going on in all three types of animals, mentioned above. Identification and classification of small ruminants have been accomplished as before as in 1990. Improvement of local goats was initiated in 1990. Identification and classification of local cattle have been done in 2003. Dhofari cattle improvement is in progress in Salalah since 1990 and that of Batinah cattle has been initiated in 2003 in Rumais. In Sultan Qaboos University, there have been conservation activities on Omani sheep and Batinah-, Jabel Akhdar- and Dhofari- goats and the indigenous poultry birds. There exists large scope to look ahead the country's rich animal genetic resources in retrospect towards conserving and enhancing their status for better utilization in diversifying the national economy in respect of country's food security and sustainable development. The present document provides, in brief, the relevant information in respect of production systems, diversity, in situ and ex situ managements, national programs, legislation, property rights and the future vision of the state of animal genetic resources in accordance with guidelines of the Food and Agriculture Organization of the United Nations.

I hope that this information is useful to all the relevant stakeholders, ministries, farmers, herders, students and researchers who are concerned with the Sultanate's animal genetic resources.

Presently, the intensive efforts are going on as per the Orders of His Majesty to establish Animal & Plant Genetic Resources Center in the Sultanate under the umbrella of The Research Council. It will have mission to promote the recognition, sustainable exploitation and valuation of the genetic diversity inherent in Oman's animals, plants and microorganisms as a natural heritage resources and goal to have Oman's collaborative organization for advancing sustainable use of animal and plant genetic resources through education, research and innovation and vision to enable APGRC to develop as a collaborative hub for all animal and plant genetic resources activities in the coming decades. It will promote the sustainable use of knowledge across economic sectors and social segments and create value from world-class research and practical innovation. This national collaborative effort will be open to the world of international science and have a specific concern for building a recognized local capacity in the field of genetic resources.

I wish to acknowledge H.E. Dr. Fuad Jaffer Al-Sajwani, the Minister of Agriculture & Fisheries for his sincere and moral support to several on-going research and development projects concerning conservation of indigenous animal genetic resources. I would like to extend my thanks to Dr. Hamoud Al-Hasni, director general of agriculture & livestock research and all the concerned staff of the Livestock Research stations for their sincere efforts in compiling the relevant information on the country's animal genetic resources and also others who have directly or indirectly contributed to bring out this valuable document.

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Undersecretary for Agriculture, Ministry of Agriculture and Fisheries

Part 1. The state of livestock diversity

1.1 Origin and history of livestock diversity

Oman is endowed with approximately 47 species of terrestrial mammals and around 10 domesticated species. Wild and domesticated mammals are a natural wealth and authentic Arabic/Omani heritage. Under the leadership of His Majesty Sultan Qaboos, Oman is well aware of the importance of its own animal genetic resources and hence attained the status of constituent member of the Global Plan of Action for food and agriculture through the Royal Decree 10/97 in 1997. After preparation of the first country report on the state of Oman's Animal genetic resources in 2003-, the Ministry of Agriculture and Fisheries started a program on how to utilize and conserve animal genetic resources in line with the basic elements and the steps used and developed by the Food and Agriculture Organization of the United Nations.

1.2 Flows of animal genetic resources

There are four Livestock Research Centers/ Stations located in Rumais, Wadi Quriyat, Jabal Akhdar and Salalah have been established with objectives to conserve indigenous breeds such as sheep and goats, Batinah and Dhofari cattle and Dhofari poultry and to improve them. There is a clear and intensive selection program to improve the genetic potential for the local breeds in different species. Regarding to cattle, the selection program for improving indigenous cattle breed is a long-term project. This program was initiated with the aim to increase the genetic potential for Omani local cattle with respect to milk and meat traits. Conservation of small ruminant indigenous breed is a challenge in Oman, as there are many local breeds and some of them are not well characterized especially at the molecular level. Many surveys have been done by Livestock Research Center to cover all the governorates in the Sultanate of Oman. Wadi Quriat Research Station had a nucleus herd/flock of Jabal Akhdar, Batinah goat breeds and local sheep while Salalah Research Station is responsible to improve the local Dhofari cow, goat and sheep breeds. Recently, gene bank was established at the animal reproduction department of the livestock research center in Rumais to do cryoconservation, we preserve sperms form two local cow breeds and soon we will have also from sheep and goats. During middle of 2014, the work will be ready to start collecting embryos and ova as well.

Figure 1. Map of Oman

1.3 Animal genetic resources and resistance to disease

The Veterinary Research Center conducting an animal disease mapping for Zoonotic and Communicable Animal Diseases. Which covered a viral (rabies), bacterial (brucellosis & Johne's disease) and a parasitic (Echinococcosis) disease in the livestock of the Sultanate? Geographic information system (GIS) based disease mapping system was developed based on 1.retrospective analysis / passive surveillance (animal rabies), 2.a cross-sectional serological study

(brucellosis & Johne's disease), 3.an abattoir based cross-sectional study and cross-sectional serological study (Echinococcosis). The results indicate towards the presence of CE in cattle, goat and camels subjected to the routine slaughtering. Moreover, serological study conducted to augment the slaughterhouse findings also indicated towards possible higher exposure to CE in local livestock. Contact with dogs and sharing of pasture were found two potential risk factors contributing towards spread of disease in local conditions.

1.4 Threats to livestock genetic diversity

According to the efforts done by the Ministry of Agriculture and Fisheries (MAF) and the Ministry of Environment and Climatic Affairs (MECA) there are not too much threatened breeds in Oman. MAF is concentrating on the conservation and management of indigenous species whereas MECA has reserved areas in different part of the country with the aim of conserving the ecosystems. MAF is supervising the existing protected areas in Dhofar and monitoring these areas to develop, maintain and conserve the breeds. It has determined the breeds, which are in dangers and ended with only Dhofari sheep and local poultry breeds in Dhofar are defined as breeds at risk.

1.5 Status of animal genetic resources

The state of animal diversity in Oman does not change too much since the first report on AnGR. However, more nucleus herd/flock is established (Jabal Akhdar goat and South local sheep breeds) to maintain them for sustainability. Updating estimates for the productive and reproductive traits for the local breeds are shown in the following tables by species.

Cattle:

There are two local cow breeds in Oman, Al-Batinah (North of Oman) and Dhofari (South of Oman). Growth and milk production traits are shown in the following table.

Growth and milk production traits of both North and South cow breeds

Trait	North Cow Breed		South Cow Breed	
	Male	*Female*	*Male*	*Female*
Average Birth Weight (Kg)	15.35	13.93	17.87	17.63
Average Weaning Weight (Kg)	70.43	55.10	85.90	80.88
Average Pre-Weaning Daily Gain (g/day)	605.93	464.64	642.86	600.00
Average Daily Milk Yield (Kg/day)	3.61		6.91	

Goats:

Six local goat breeds are characterized in both phenotypic and genetic level. These breeds are Al-Jabal Al-Akhdar, Batinah, Dhofari, Jabbali, Sahrawi and Sahrawi Musandam. The following table shows growth and milk traits for the local goat breeds (annual book for agriculture and livestock research, 2013)

Average growth and milk traits for local goat breeds

Breeds	Sex	BW (Kg)	WW (Kg)	W6 (Kg)	Pre-Weaning Gain (g/d)	Post-Weaning Gain (g/d)	Daily milk yield (kg/d)
Jabal Akhdar	*Male*	3.07	13.98	19.77	108	42	1.12
	Female	2.76	13.67	19.22	106	40	
Batinah	*Male*	3.48	15.02	20.13	118	34	1.05
	Female	2.99	13.50	18.35	101	33	
Dhofari	*Male*	3.23	13.12	15.25	91	15	1.49
	Female	2.94	12.47	13.99	88	12	
Jabbali	*Male*	3.26	17.69	26.30	144	63	1.10
	Female	3.00	14.76	21.32	118	48	
Sahrawi	*Male*	2.77	16.31	24.91	130	70	1.15
	Female	2.71	14.31	21.27	113	63	
Sahrawi Musandam	*Male*	2.63	14.48	22.41	118	55	1.00
	Female	2.43	13.12	18.35	99	40	

Sheep:

Two local breeds are defined, the North of Oman and the South of Oman. The last one called Dhofari sheep and there were no information available for that breed at the first report for AnGR in Oman. In 2013, a selected pure animal was collected from the farmers to establish a nucleus herd and the breeding program was adapted to the herd in order to improve the target productive and reproductive traits. Phenotypic characterization of the south breed showed that body is covered with short wool. Legs are fine and small in length and the head is small. Nose is straight while neck is of medium length. Ears are of medium length and the udder is medium size with teats varying in length. Both males and females are hornless. However, few males may carry small horns. Tail is short and thin and always hangs down. The breed is found in the South of the Sultanate (Dhofar governorate) and raised under medium -input production system and used for milk and meat production. Basic estimates for the South sheep breed will present in the following table

Average growth and milk traits for local sheep breeds

Breeds	**Sex**	**BW (Kg)**	**WW (Kg)**	**W6 (Kg)**	**Pre-Weaning Gain (g/d)**	**Post-Weaning Gain (g/d)**
Local Sheep (North)	*Male*	2.78	17.19	22.40	133	47
	Female	2.66	15.81	22.05	123	56
Local Sheep (South)		1.9	12.10	14.75	--	--

Camels:

Omani camels are Arabian camels and they are all one-humped, generally of medium size weighing around 350 – 450 kg and 2m in height with strong limbs and beautiful colors specific to different areas of the Sultanate. In the Southern governorate, the camels tend to be black while in the Northern governorate they are red, blonde, or white . Omani camels originally bred from Arab camels in the Arabian Peninsula and Yemen, have acquired hybrid features due to crossbreeding. To preserve lineage of camels, crossbreeding has been banned. Omani camels can be classified as multipurpose camels that are good for riding, racing, and for producing meat and milk. Some Omani tribes are famous for their specific types of camels. The Omani camels are renowned for their speed, strength, straightness of legs, and larger than normal eyes.

They are considered to be of the best pedigree among the camels living in the Arabian Peninsula (James Raymond Welstid, Oman's History 2002).

The studies can be undertaken to characterize features and pedigree of the camels belonging to the different Omani tribes has allowed nomenclature according to the Omani tribe in which the camel existed. Care taken in the selection based on specifications and features had led to emergence of authentic camels that were given names based on tribes that they belonged. There are characteristic features and differences among different camel populations according to which and to other local knowledge, they are characterized into the groups / pedigrees (Website of the Royal Court Affairs, Oman). The most famous types are Samha, Musiha, Fariha, Khumaisa, Khiwara, Ramli, Khuzami and Jabali.

Horses:

Historically, Oman has been famous for its purebred Arab horses. Some historians date the origin of Arab horses in Oman to the time of Prophet Suleiman who presented an Azd delegation with the famous stallion (Zad-Arr-akib) from whom all the Arab horses in Oman have descended. Horse breeders knew how to preserve and maintain bloodlines by specifically breeding only top class animals, believing that the horse is the image of his master and a reflection of his courage, stamina and ability.

In 1970, with His Majesty Sultan Qaboos bin Said's accession to the Omani throne, new directives were implemented pertaining to the breeding and care of Arab horses. The Royal Stud Farm was built in the mid-1970's in Salalah as a department of the Royal Stables designed to breed the best quality horses with the emphasis on Arabs and thorough breeds. The Royal Stud continues to play an important role in horse breeding each year.

Characteristics of Omani horse

Omani horses are Arabian horse has a small head, proportionate to the rest of its body; large eyes; small, pointed, erect ears; and a short, wide back. Due to their pure bloodlines, Arab horses maintain good health and rarely succumb to illness. They eat less than other breeds and have great endurance for long journeys. Arab horses have a variety of colors, but the most prized is the white. Each horse is given an Equine Passport by the Omani Horse Register (OHR), which is the equivalent to its identity card.

Poultry:

The local Omani poultry population is low and it considered as at risk, the selection program ended with three local strains, white, black and brown. An experimental was carried out during year 2010-2012 to compare the productive traits of the three local poultry lines (white, black and brown). The results of the activity indicated the brown line was similar to white one in respect of growth and productive traits whereas the black line was found to be inferior. It was concluded from the results to keep both the white and brown lines for undertaking intensive selection program to improve the traits and the black line would be maintained as an important genetic resource. The following table presents the results of poultry research work.

Average productive and growth traits for the three poultry lines

Trait	White	Black	Brown
Average Day one Body Weight (g)	29.2	28.0	30.8
Average 6 week Body Weight (kg)	1.21	0.490	1.05
Average 10 week Body Weight (kg)	1.99	1.00	1.82
Average 21 week Body Weight (kg)	2.22	1.30	2.27
Average marketing Weight (kg)	1.72	1.46	1.57
Conception (%)	86.39	87.16	87.14
Hatching (%)	53.93	36.68	54.85
Egg Weight (g)	44.87	43.18	46.72
Average Egg Production (Egg)	183.74	76.09	146.21

It can be concluded that priorities in capacity building are needed to understand biodiversity situation of important local breeds, which would focus on training of Omani cadres in the application of genetic improvement techniques using genetic markers, identifying genetic loci affecting quantitative traits and identification of breeds through measuring genetic distances and protein polymorphism. Also, among the priorities is the characterization of the non-characterized populations in the rural areas.

Part 2. Livestock sector trends

2.1 Agriculture and Livestock Sector

Nowadays agriculture in Oman has witnessed a paradigm owing to the great development and the utilization of cutting-edge technologies in line with the quantum leap that took place in the field of agriculture worldwide. A great number of distinguished agricultural projects were executed in all governorates of the Sultanate, the owners of these projects have exerted considerable efforts and benefited from the latest technologies like the modern irrigation systems, greenhouse farming and mechanized farming, all these methods brought about a dramatic increase in the agricultural yield coupled with high-quality produce. Today, agriculture accounts for a substantial amount of the country's income from non-oil generated revenue, accounting for 26.5 per cent of all non-oil/gas exports. It also provides livelihoods for tens of thousands of the country's citizens with around 60 per cent engaged in crop cultivation. As per the Agricultural Census figures, they help to produce 1,202,000 tons of crops from 72,000 hectares of cultivated land. With the outlined projected growth target of 2.6 per cent being not only met but bettered, Oman's agricultural sector is receiving an added boost thanks to newly introduced methods coupled with extensive research that has allowed for even greater productivity and generated greater additional revenue for this important part of the Sultanate's economy. The indigenous livestock production in the Sultanate is on the increase. The production of red meat, poultry, eggs and milk now stands at 12,800 tons, 23,000 tons, 185 million and 135 million liters per year respectively. The number of livestock owners for cows, camels, goats, and sheep in Oman now stands at over 42,861; 14,947; 69,940 and 28,398 respectively. Similarly, the total number of animals in 2009 increased and it stood at 326,420 for cows, 126,970 (camels), 1.6 million (goats), and 379, 966 (sheep) respectively. The ministry has had good results with its Animal Feed Manufacturing from farm residue, artificial insemination program for cows, genetically improved selection of goats and sheep in association with the Sultanate’s four livestock Research stations in Rumais (Barka), Wadi Quriyat (Bahla), Jabal Akhdar (Nizwa) and Salalah.

2.2 Feed Resources and its related to the animal population in Oman

The ruminant population in Oman and their nutrient requirements are given in following table. These data indicate that small ruminants (sheep and goats) represent 45% of total animals units in Oman whereas Cattle and camel represent 28% and 27% respectively. These figures clearly indicate the important of small ruminants especially goats in animals farming system in Oman. According to recent census, the population of ruminants has been increased by 39% from 2004 to 2013. Goats, sheep, cattle and camel increased by 35%, 53%, 18% and 100% respectively.

Although small ruminants are steadily increasing, but unfortunately this is not matched by an increase in feed resources in the country. In fact, feed shortage constitutes a great threat for efficient production of small and large ruminants in the Sultanate.

Number of ruminants and their nutrient requirements in Oman

Animal Type	Number (000)	Animal Unit* (000)	DM** (000Ton)	ME (000MJ)	CP (000Ton)
Sheep	548.231	87	208.8	1609.5	19.575
Goat	2085.206	313	751.2	5790.5	70.425
Cattle	359.507	252	604.8	4662.0	56.700
Camel	242.833	243	583.2	4495.5	54.675
Total	3235.777	895	2148	16557.5	201.375

*Animal Unit= Dairy cow weight 300kg and producing 1000kg milk with fat5%.
One Animal Unit is equivalent to 1.00 camel, 0.70 cows, 0.16 sheep and 0.15 goats.
** Annual DM Need of a Animal Unit = 2.4 MT

Local production (1000 ton) of some livestock products

Production	2009	2010	2011
Red meat	13.26	24.00	24.48
Milk	49.57	69.60	70.99
Poultry meat	21.00	42.10	41.40
Table egg (million)	187	183	213

It was estimated that the total feed requirements for these animals are about 2.148 million tons dry matter (35% for goat, 10% for sheep, 28 % for cattle and 27% for camels). The total feed resource available for the ruminants was about 959 thousand tons dry matter. Natural rangeland contributed for about 60%, whereas green fodder represented about 20% of total feed resources. The contribution of cereal crop residues, by-products flour mill (wheat bran), agro-industrial by-products (date processing), inferior quality dates fruit and sun dried sardines fish were 1.25%, 12.5%, 1%, 2.75% and 2.5% respectively. Feed balance between requirement of animals and the resources available was found to be negative 55%, 53% and 49% for dry matter (DM), metabolizable energy (ME) and crude protein (CP) respectively. In order to fill part of feed gap between supply and demand of feed resources in Oman three big Feed Mill are producing different types of concentrate and complete feeds. More than 95% of concentrate feed ingredients locally by feed mill in Oman are imported from international market.

Feed resources available for ruminant in Oman

Source	DM (000MT)	Contribution (%)	ME (000MJ)	CP (000MT)
Natural rangeland	575	60	4312.5	46.0
Green fodder	190	20	1520.0	22.8
Cereal Crop residues	12	1.25	60.00	0.600
Wheat Bran	120	12.5	1200.00	16.8
Sun Dried Sardines Fish	25	2.50	312.5	15.0
Inferior Quality Dates Fruit	27	2.75	337.5	1.350
Dates Processing by-products	10	1.0	100.00	0.500
Total	959	100	7812.5	103.05

Number[1] of holding livestock and total number of animals by governorate and species

Governorate	Cattle		Camels		Goats		Sheep	
	No. of Animals	*No. of Holdings*	*No. of Animals*	*No. of Holdings*	*No. of Animals*	*No. of Holdings*	*No. of Animals*	*No. of Holdings*
Muscat	5492	866	469	56	74761	3048	21423	1835
Dhofar	207891	5333	145875	5696	278499	5190	14403	702
Musandam	333	65	17	4	126020	1965	12818	581
Al Buraimi	5890	802	4128	267	83498	1521	38714	1078
Al Dakhilia	18063	4149	10118	1419	220780	8400	54967	4606
Al Batinah North	67119	7356	9667	1336	338785	12932	130269	6727
Al Batinah South	23113	3561	8262	852	151724	5655	48956	2432
Al Sharqiyah South	9260	2722	17463	2912	303067	9919	73101	5474
Al Sharqiyah North	8431	2610	21577	3015	242670	7686	70870	5259
Al Dhahirah	13914	2924	6006	932	163528	6020	61518	3617
Al Wusta	1	1	19251	1559	101874	2371	21192	1045
Total	359507	30389	242833	18048	2085206	64707	548231	33356

1 Oman Agriculture Census, 2013

Number[2] of imported animals (2012)

Cattle	188206
Goat	961656
Sheep	444808
Camel	12322

2 International trade statics book (2012)

Number[1] of livestock (cow) by sex, breed and governorate

Governorate	**Males**		**Females (Immature)**		**Females (matured)**		**Total**
	Local breeds	*Imported breeds*	*Local breeds*	*Imported breeds*	*Local breeds*	*Imported breeds*	
Muscat	2407	1124	308	9	1539	105	5492
Dhofar	17693	712	38257	3170	136942	11117	207891
Musandam	91	0	41	0	201	0	333
Al Buraimi	1261	11	883	14	3641	80	5890
Al Dakhilia	8733	3255	1093	67	4669	246	18063
Al Batinah North	16367	1550	6268	2236	25149	15549	67119
Al Batinah South	9253	2346	2194	139	8507	674	23113
Al Sharqiyah South	2206	26	1390	2	5604	32	9260
Al Sharqiyah North	2847	1419	764	36	3146	219	8431
Al Dhahirah	4011	188	2070	43	7503	99	13914
Al Wusta	0	0	0	0	1	0	1
Total	64869	10631	53268	5716	196902	28121	359507

1 Oman Agriculture Census, 2013

Number[1] of livestock (camel) by sex, breed and governorate

Governorate	Males		Females (Immature)		Females (matured)		Total
	Local breeds	*Imported breeds*	*Local breeds*	*Imported breeds*	*Local breeds*	*Imported breeds*	
Muscat	100	0	25	0	343	1	469
Dhofar	10826	13	31008	26	103892	110	145875
Musandam	4	0	1	0	12	0	17
Al Buraimi	233	0	306	0	3589	0	4128
Al Dakhilia	1170	4	529	0	8414	1	10118
Al Batinah North	1470	2	1053	1	7134	9	9667
Al Batinah South	1351	0	1182	0	5729	0	8262
Al Sharqiyah South	1387	64	3042	66	12615	289	17463
Al Sharqiyah North	2508	6	3394	0	15669	0	21577
Al Dhahirah	767	5	869	0	4365	0	6006
Al Wusta	41	0	3359	0	15851	0	19251
Total	19857	94	44768	91	177613	410	242833

1 Oman Agriculture Census, 2013

Number[1] of livestock (goat) by sex, breed and governorate

Governorate	Males		Females (Immature)		Females (matured)		Total
	Local breeds	*Imported breeds*	*Local breeds*	*Imported breeds*	*Local breeds*	*Imported breeds*	
Muscat	16742	3105	9329	116	44947	522	74761
Dhofar	24179	35	43768	16	210413	88	278499
Musandam	23833	37	16835	26	85244	45	126020
Al Buraimi	10658	14	11262	31	61462	71	83498
Al Dakhilia	41302	1935	23355	161	153571	456	220780
Al Batinah North	52549	1660	5001	278	232955	1342	338785
Al Batinah South	34016	715	25081	130	91320	462	151724
Al Sharqiyah South	56550	2247	50538	1122	188211	4399	303067
Al Sharqiyah North	48018	980	36924	69	156430	249	242670
Al Dhahirah	25681	480	26475	93	110482	317	163528
Al Wusta	1843	0	19318	0	80713	0	101874
Total	335371	11208	312886	2042	1415748	7951	2085206

1 Oman Agriculture Census, 2013

Number[1] of livestock (sheep) by sex, breed and governorate

Governorate	Males		Females (Immature)		Females (matured)		Total
	Local breeds	*Imported breeds*	*Local breeds*	*Imported breeds*	*Local breeds*	*Imported breeds*	
Muscat	4588	366	2943	69	13106	351	21423
Dhofar	1756	28	2053	29	10404	133	14403
Musandam	2423	63	1824	25	8360	123	12818
Al Buraimi	5065	441	5076	300	26160	1672	38714
Al Dakhilia	10902	849	6617	199	35650	750	54967
Al Batinah North	18895	533	20008	239	89422	1172	130269
Al Batinah South	8616	7791	6857	125	25154	413	48956
Al Sharqiyah South	12688	2083	12956	1307	40648	3419	73101
Al Sharqiyah North	14566	453	11322	87	44041	401	70870
Al Dhahirah	8999	734	8886	1021	37849	4029	61518
Al Wusta	181	0	3282	0	17729	0	21192
Total	88679	13341	81824	3401	348523	12463	548231

1 Oman Agriculture Census, 2013

Part 3. The state of capacities in animal genetic resources management

3.1 The state of implementation of the Global Plan of Action at national and regional levels

During the five-year strategic plan (2010-2015) for agriculture and livestock research, the ministry of agriculture and fisheries conducted many regional and national programs to develop and guarantee the sustainable use of the animal genetic resources in Oman. A summary of these programs is as follow:

- There is a regular meeting every three months between the researchers at MAF and all stakeholders to put the short and long-term objectives and to distribute the costs of national breeding programs.
- In the international trade for breeding animals, special emphasis is taking into account to maintain Oman's good animal health status.
- a gene bank was establish in year 2013 to start the cryoconservation for the indigenous sperm, ova and embryo and an international cooperation between the gulf countries will be start soon in this field.
- Existing *in-situ* conservation programs are extended by establishing two nucleuses herd and flock for Jabal-Akhdar goat breed and the south local sheep breed (Dhofari) which is in danger.
- For the case for serious animal disease, the veterinary research center conducting an animal disease mapping for Zoonotic and Communicable Animal Diseases. Which covered a viral (rabies), bacterial (brucellosis & Johne’s disease) and a parasitic (Echinococcosis) disease in the livestock of the Sultanate?
- Complete database will be ready to use in the management of *in-situ* and *ex-situ* programs and integrated approach by governments and international institutions in progress for food security that makes links with climate change, biodiversity, and use of energy, water and land.
- The MECA is finalizing the second biodiversity strategy for 2020, which aims to halt the loss of biodiversity and ecosystem services with good collocation with MAF, and high supports of the Convention on Biological Diversity (CBD) commitments made in Nagoya in 2010. In particular, Action 10 of the Strategy.
- The existing breeding program has pedigree registration and accurate recording systems.
- There is an efficient use of DNA analysis techniques in particular for goats.

- Oman government supports a number of international agreements to encourage the
- Conservation and sustainable use of AnGR. Significant progress has been made by MECA to strengthen action in relation to biodiversity, including through the Convention on Biological Diversity (CBD).
- In 2012, His Majesty Sultan Qaboos issued a royal decree to establish Oman animal and plant genetic resources center (OAPGRC). An impressive amount of efforts has been in establishing an Animal and Plant Genetic Resources Center.

Aim and Objectives of the (OAPGRC)

- Establishing a nucleus herds and flock for the breeds which defined to be at risk
- Create a comprehensive gene bank database in Oman and connected it with other gulf countries.
- Conserve animal and plant genetic resources using *in-situ* and *ex-situ* conservation.
- OAPGRC is proposing to start a big campaign mainly aiming to establish a platform for mutual learning and dissemination of knowledge for understanding the concept of the genetic resources by strengthening the dialogue between scientists and the community.
- Educate and raise awareness on genetic resources to non-experts and professionals.
- Participating with other related organizations to implement the action plan that includes taking forward work on the conservation, characterization and sustainable use of animal and plant genetic resources in Oman.

3.2 Structured breeding programs

Genetic improvement for local farm animal breeds started in the 1990's with the aim of conserving the indigenous breeds by conducting genetic improvement using a clear selection programs of the productive and reproductive traits especially milk and meat production. The selection program for improving indigenous cattle, sheep and goats breeds is a long-term program. The first goal for this program is to increase the genetic potential for Omani local breeds with respect to milk, meat and other reproductive traits. The objectives of the breeding program are to 1) Determine the genetic potential of the indigenous breeds and identify molecular markers linked to quantitative traits loci (QTL) for production traits using molecular techniques. 2) Perform the progeny test for the improved males. 3) To have a sufficient and efficient database with full pedigree information.

The ministry of agriculture and fisheries distributes every year a large numbers of improved males to the farmers to do genetic improvement for their herds/flock and monitor the performance of these distributed animals on farm.

3.3 Conservation programs.

The ministry of agriculture and fisheries (MAF) do many efforts to conserve and maintain the local breeds in different livestock species with collaboration with the ministry of environment and climatic affaires and the royal court affaires. MAF is supervising the existing protected areas in Dhofar and monitoring these areas to develop, maintain and conserve the breeds. It has determined the breeds, which are in dangers. Only Dhofari sheep and local poultry breeds in Dhofar are defined as breeds at risk.

In-Situ management

In Situ conservation and management of AnGR in the country are carried out by the Ministry of Agriculture and Fisheries and the Ministry of Environment and Climatic Affairs (MECA). MAF is concentrating on the conservation and management of indigenous species whereas MECA has reserved areas in different part of the country with the aim of conserving the ecosystems. In 2004 a special program started to do classification and identification for the local small ruminant and cow breeds in Oman. MAF has nucleus herd/flocks in different area in Oman to maintain and preserve the local breeds at their native place. There exist numerous activities towards conservation of local breeds in different species, through on-form management since early 1990's. In case of cows and small ruminants, MAF takes responsibilities to carry out genetic improvement at its different research centers and stations using a reliable selection program and distribute the selected improved rams/bucks to the farmers and small holders to improve their herds/flocks. However, there is a need for extending such activities towards improving indigenous breeds of AnGR.

In 2013, a nucleus herd of Al-Jabal Al-Akhdar goat breed was established in Aljabl Al-Akhdar city to conserve the breed. Al-Jabal Al-Akhdar breed is an important goat breed in Oman and some other gulf countries, it is a promise breed. Average conception rate is 95% and kidding rate is 1.3. The breed is widely used for meat production. This activity carried out to maintain the breed (*in-Situ*) conservation as an important genetic resource in Oman. The main objectives for this activity are: 1) Conserve and maintain Al-Jabal Al-Akhdar goat breed in its native place (*in-Situ*), 2) Preservation the breed from the genetic degradation and random crossing, 3) Genetic improvement for the productive and reproductive traits for sustainability and to propagate the breed and disseminate the selected improved males to the farmers at the target areas.

Another important step started in year 2014 to conserve the Dhofari sheep breed (South local sheep) which is at risk. A selected nucleus flock was established at its native place to conserve the breed and do apply an intensive breeding program to improve productive and reproductive traits.

Ex-Situ management

MAF started a program in 2010 to conserve AnGR *Ex Situ* by establishing an international artificial insemination laboratory at Livestock Research Center with the aim of collecting and preservation of semen produced from local improved bulls in order to maintain. Shortly, this lab will be a national gene bank for cryoconservation of sperms, ova and embryos.

3.4 Reproductive and molecular biotechnology

The artificial insemination research lab provides high quality semen produced from local improved bulls, for using in artificial insemination at the breeders in different governorates of the Sultanate. This is useful in accelerating the processes of genetic improvement by reducing the generation interval as well as the possibility of testing bulls by doing the progeny test. Bulls are selected according to 1), high breeding value for milk yield of the mother, 2), morphological and reproductive shape of the testes and good body conformation and semen quality.

The genetic diversity between livestock is an important indicator for experts and researchers in the field of livestock management. It assists them to design breeding programs, improve quality and enhance productivity of the livestock. Subsequently this leads to raising the efficiency of its genetic origins as well as preserving it from genetic drift. Molecular characterization of the genotypes gives precise information about the extent of genetic diversity, which helps in the development of an appropriate breeding program.

Genetic characterization study of indigenous goat populations of Oman using microsatellite DNA markers was done to know the relationship between the local goat breeds in all governorates in Oman.

In this study, a total of 23 SSR markers were used across 16 Omani goat breeds for their characterization and discrimination. The total number of alleles found was 743. The number of alleles per locus ranged from 12 alleles (ETH10) to 58 alleles (BM6444), with an average of 32.3 alleles across 23 loci obtained in the study. The polymorphic information content values ranged from 0.593 for MAF209 to 0.949 for BM6444 with an average mean 0.839 over all the markers. BM6444 was found the best marker for the identification of 16 genotypes as revealed by PIC values. The pair-wise genetic dissimilarity co-efficient indicated that the highest genetic distance (0.586) was between Musandem (MU) and Dhofari breeds (DO) while the smallest genetic distance (0.220) was observed between Al Sharqiyah (JSQ) and Al Dakhliya (DK). The microsatellite marker based molecular fingerprinting could serve as a sound basis in the identification of genetically distant breeds as well as in the duplicate sorting of the morphologically close breeds. This study is the first one to investigate the genetic diversity in Omani goat breeds using molecular techniques. The information obtained from this study will provide a useful genetic background for conserving and utilizing native goat breeds in the sultanate of Oman. The study indicates significant genetic diversity among Omani goat breeds. There was a close relationship between Jabali Al Sharqiyah and Al Jabal Al Akhdar goat breeds however; there was a wide genetic distance between Sahrawi Musandem and Dhofari goat breeds.

Further work at the molecular level is on going with local cattle breed to investigate the origin and relationship between Omani breeds and the other breeds in the gulf countries.

3.5 Legislation and regulation

The government, in more than anything else, enacts legislation and issues the regulations related to the development and maintenance of AnGR. Several legislations and regulations have been issued since the past 10 years that deal with conservation and utilization of AnGR. Most of them were issued in the form of royal decrees addressing specific issues as follows:

- The Royal Decree No. 119/1994 on approving to join Oman in the biodiversity agreement,
- The Royal Decree No. 43/1996 concerning the law on the veterinary business and opening the private veterinary clinics,
- The Royal Decree No. 114/2001 concerning the law on conservation of the environment and prevention of pollution,
- The Royal Decree No. 6/2003 related to the law on natural reserves and wildlife conservation,
- The Royal Decree No. 8/2003 on the law of rangelands and animal wealth management,
- The Royal Decree No. 45/2004 on the law ok veterinary quarantine,
- The Royal Decree No. 48/2004 on setting up the agriculture and fisheries developmental funds,
- The Royal Decree No. 48/2006 on law of agriculture.

The implementation of these lows and regulations need to be monitored effectively to have positive impact on the utilization and conservation animal genetic resources and to take advantage of opportunities that arise with them.

Part 4. Needs and challenges in animal genetic resources management

There are challenges in animal genetic resources management in particular to increase the awareness for the farmers and children. In addition, there is a need to increase the training and capacity building. The government contributes greatly to develop the infrastructure and capacity building through the university graduation and missions sent abroad. The government contributes to the extension and supporting farmer services to improve the technical level for them. The ministry of education started last year to include some syllabuses related to understanding of AnGR for students at the primary schools.

The future vision of the State of AnGR addresses the following:

- Initiate the genetic characterization at the molecular level for all local breeds which is already finished at the phenotypic level i.e. cattle and sheep.
- Registration for the local Omani breeds to preserve the property rights.
- Activate of the existing coordination between the researchers and farmers.
- Initiate a comprehensive approach that regulates the work between conservation and utilization of animal genetic resources.
- Provide the requirements of manpower and financial resources needed for the maintenance of AnGR.
- Establish the database for farm animal genetic diversity.
- Conduct more research work on breed evaluation and preparation of a national applied research program on livestock and improving the efficiency and spread of extension services.
- Enhance the cooperation between the Sultanate and the neighbouring gulf countries in the basic and applied research like breeding and improvement of local breeds of poultry, sheep, goats and camels; developing and transferring appropriate biotechnologies and establishing joint projects between them.
- Promoting collaboration between the Sultanate and countries of Gulf Cooperation Council in developing information systems and communication networks, in addition to control epidemic diseases through a joint strategy to control animal movement involving other concerned countries.

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