

**Country Report on the
State of Animal Genetic Resources (AnGR)
In the
Sultanate of Oman**

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LIST OF ABBREVIATIONS

ACSAD	: Arab Center for the Studies of Arid Zones and Arid Lands
AI	: Artificial Insemination
AnGR	: Animal Genetic Resources
AOAD	: Arab Organization for Agricultural Development
FAO	: Food and Agriculture Organization of the United Nations
MOAF	: Ministry of Agriculture and Fisheries
NGO	: Non-Governmental Organization
SoW	: State of the World (AnGR)

I. ASSESSING THE STATE OF AGRICULTURAL BIODIVERSITY IN FARM ANIMAL SECTOR OF THE COUNTRY

1.1 Introduction

Sultanate of Oman is situated in the south-eastern most of the Arabian Peninsula. It extends between latitudes 16° 20' and 26° 20' north and between longitudes 51° 50' and 59° 40' east. Omani coast extends from the Strait of Hormuz in the north to its borders with Yemen in the south. The Sultanate is bordered by United Arab Emirates and Kingdom of Saudi Arabia in the east, Yemen in the south, Strait of Hormuz in the north, and Arabian Sea in the east.

Oman commands an area of 309500 km², being the second largest country in the Arabian Peninsula. Topography ranges from plains to steppe and mountains. The coastal plain on the Gulf of Oman and Arabian Sea is the most important plain with an area of 9500 km² (i.e. about 3% of the total area). Mountains occupy an area of 47000 km² (i.e. about 15% of the total area) and they form two chains, Hagar extending in a curve from Ras (Cape) Musandam to the north to Ras Alhad, and Qara chain in the south-westernmost of the Sultanate. Desert and sandy regions occupy the greatest area amounting to 253000 km² (about 82% of the total area) and they belong mainly to the Empty Quarter. Weather is hot humid in the summer in the coastal plains and hot dry in the interior except in the mountains where it is moderate all year round. Average annual rainfall is 100 mm near the coast and less in the interior but it can get up to 350 mm in the mountains.

Oman depends on ground water fed by rains falling on the mountains. Ground water is utilized through open and artesian wells plus a network of canals and ducts collecting spring water and reaching cultivated land by gravity.

Administratively, the Sultanate is divided into 59 states in eight administrative regions (governorates), Muscat, Musandam, Zufar, Albatinah Region, Interior Region, Eastern Region, Zahra Region and Middle Region.

Human population was 2 million according to the first census conducted in 1993 reaching 2.3 million in 1999 with an annual growth rate of 2.4%. According to definitions used in the country, 66.2% of the total population is urban while 33.8% is rural population. It is worth mentioning that a great number of Omanis practice agriculture as main or secondary occupation.

Detailed surveys conducted by Ministry of Agriculture and Fisheries indicated that there are 2.3 ha cultivable land. To make use of this land requires the establishment of groundwater maps in order to identify the optimum location where future expansion may be recommended.

According to the final results of the comprehensive agricultural census conducted by the Ministry in 1993, the total number of landholdings in 1993 was 95145 of which 26741 was for crops only, 32622 for livestock only, 14 for poultry only and the rest is mixed. Albatinah Region represented the highest number of holdings (33.6%) compared to 19.7% for the Eastern Region, 16.6% for Zufar, 12% for Interior Region, 9.3% for Zahra Region, 3.8 for Muscat, 2.5% for Musandam and 2.1% for the Middle Region.

Total area for all agricultural land holdings was 241300 feddan (101350 ha). Land actually cultivated was 146500 feddan (61530 ha).

Surveys conducted in 2001 indicated that the total crop area was about 176000 feddan (74000 ha) distributed as 58% date palms and fruits, 25% perennial fodder crops, 9% vegetables and 8% field crops.

Berseem was cultivated in about 27300 feddan (11500 ha) with an estimated production of 487100 ton, while Rhodes grass was cultivated in 16000 feddan (6720 ha) with an estimated production of 278400 ton.

Generally, the Sultanate may be characterized as having poor plant cover. Grazing area is estimated as 17 million ha with an estimated productivity of 200 kg of green matter. Zufar has got relatively the most dense plant cover because of monsoon rains in the fall on mountains. Grazing area in Zufar is estimated as about half a million hectare.

Animal resources vary from one region to another. According to 2001 statistics, estimated numbers are 313500 cattle of which 74% in Zufar, 12% in Albatinah, 4% each in Zahra, Interior and Eastern Regions while the rest in the other regions. Prevailing cattle production system is moderate input. Camels were 11600 of which 71% in Zufar, 9% in Eastern Region, 7% in the Middle Region, 6% in Zahra, about 4% in Albatinah and 3% in the Interior. Camels are mainly raised under low-input system. Sheep population was 254000 of which 31% in Albatinah, 22% in Eastern Region, 20% in Zahra, 13% in the Interior, 5% in Muscat, 4% in the Interior, 3% in Musandam and 2% in Zufar. Sheep are mostly produced under nomadic or semi-nomadic (transhumant) system with moderate input. Goats were 998000 of which 23% in Albatinah, 19% in the Eastern Region, 17% in Zufar, 15% in Zahra, 9% in the Interior, 8% in the Middle Region, 7% in Musandam and 2% in Muscat. Goats are raised mostly under nomadic and transhumant system with moderate inputs. Statistics for poultry are from commercial flocks which are exclusively dependent on exotic stocks while statistics on local poultry are inaccurate. The Sultanate has got also a modest population of horses, asses and mules but there are no dependable statistics regarding them. Such statistics should become available through the second agricultural census planned for 2004/05.

The first agricultural census in 1993 indicated that total number of permanent agricultural laborers was 141000. It is difficult to estimate the number of those laborers involved in livestock activities since mixed agricultural holdings (i.e. plant and animal production) are the prevailing type of landholdings.

In 1999 red meat production was estimated as 8841 ton as compared to 7461 in 1990. Poultry meat production was estimated as 7500 ton in 1999 as compared to 3400 in 1990. Local fresh milk production from cattle increased from 33350 in 1990 to 39200 in 1999 and table eggs as 1990 ton and 4800 ton, respectively. Self sufficiency rate was 23% in sheep and goat meat, 46% in beef, 16% in poultry meat, 16% in poultry meat, 45% in eggs and 53 in fresh milk.

The livestock sector is managed by the private sector supported by the State through extension services and investment facilitation. Livestock production units are characterized by their small size and an absence of administrative organization. There are promising specialized commercial dairy and poultry farms but their numbers are still limited.

Recently there have been trends of accelerating growth in broiler and egg production due to the high return on the investment, availability of investment facilities and the planning and supervision by the State. Other livestock activities are stable.

The Sultanate took significant steps to realize food security through enhancing domestic agricultural production which helped the increase in the self sufficiency rate in some products like milk and table eggs. However, self sufficiency rate still low in some other products like red meat and poultry meat.

However, despite this low self sufficient rate, the Sultanate does not suffer from lack of food due to its economic ability to import its needs under free market conditions beside surplus in other items like dates and fish.

There has been noticeable increase in demand on agricultural products due to the significant growth in the human population and the increase in health awareness. This applies nearly equally for both the urban and rural populations, especially in the presence of a relative stability in population distribution, distribution of income and the limited internal immigration. It is noticed that rural poverty is on the decline lately because of steps and procedures taken by the government to improve standard of living in all regions and the fair distribution of development projects.

Demand on animal products has increased lately especially on red meat, poultry meat, eggs and milk as evidenced by statistics on the imports of these products. Significant changes have also taken place in the agricultural production systems towards intensification, where there is large increase in high-input production systems in poultry and dairy cattle due to the increase in demand, high economic returns and the investment facilities offered by the State. There has also been a concomitant increase in attempts to increase local feed production but lack of water resources has proven to be a great obstacle to achieve this.

Due to the particular environmental factors of the Sultanate, mainly shortage of water for irrigation and the high temperature and humidity, it is not expected to meet the demand on animal products in the future by increasing the number of animals but it is promising to meet such increasing demand on animal products by improving productivity through genetic improvement of local breeds and expanding specialized— production projects which utilizes high productive exotic breeds.

1.2 Production Systems

Producers in the Sultanate follow traditional animal production systems like nomadic and transhumance but stationary systems exist in agricultural holdings including backyard systems and small units. This is in addition to large scale intensive commercial systems.

In the nomadic system, the livestock owner moves with his animals after pasture and water. This system is low or medium input and it prevails in desert and mountain areas. Camels, goats and sheep are usually raised in this system in small flocks/herds. The transhumance system is similar to the nomadic system to a great extent but the livestock owner would have a stationary residence and he moves to and from this residence. Also the herd size is larger in the transhumance system. Both systems use local breeds and depend on natural pasture plus supplemental feeding with green fodders, hay and straw, dates and their byproducts and fish byproducts. Nomadic and transhumant systems are, at

present, considered in a transitional stage as they could transform into stationary systems as development in rural areas goes on, i.e. establishment of administrative centers, schools, drinking water, roads, availability of feed stuffs etc. Camels have the highest representation in these systems followed by goats and sheep.

In the backyard systems, usually small flocks/herds of sheep, goats, cattle or local poultry are raised mostly in mixed species. The owner keeps his livestock in a facility near his house where the animals go out grazing in the neighborhood in the morning and come back in the evening when he gives them supplemental feeds and water.

Small landholdings include small flocks/herds of goat, sheep, cattle and local and exotic poultry which make use of fodders grown in these farms. Lately, there has been improvement in animal production through the introduction of modern techniques and the government making available inputs and extension services. The systems of backyard and small farms are considered medium-input systems where most cattle, sheep and goats are produced. In Zufar, cattle are produced under a stationary system where they graze in some parts of the year but provided with feeds in times of lack of natural pasture. This system is self-sustained in view of its dependence on local breeds and the use of local feed resources like dates and their byproducts and agricultural and fish byproducts.

Drought, desertification and overgrazing present great danger for the nomadic, transhumant and stationary production systems. They cause great deficiencies in feed stuffs leading to higher production cost. However, the discovery of oil has changed the way of life to more settling in many regions due to increasing employment and services. This has positively impacted the traditional animal production systems from both management and production aspects.

Large commercial farms are owned by big specialized companies. In these systems, stocks are kept in fixed places, well managed and environmentally controlled. Modern techniques are used in production, feeding and watering.

High prices for imported breeds and lack of capital and skilled labor are considered as the main factors negatively impacting specialized livestock production. This is in addition to the hesitance of the private sector in investing in specialized livestock projects. The reasons for this hesitance are the high production costs, unfavorable environmental conditions, poor marketing system and competition from imported products. Ownership of farms in the aforementioned systems is private.

1.3 Most Important Animal Products

Meat and milk are the most important products from cattle while meat is the important product from sheep and goats, while meat and eggs are the main products from poultry. Goats produce more than half of the skins produced in the country while cattle are the first source of manure followed by goats, then sheep and finally poultry litter. There are no real regional differences in the relative importance of these products.

Camels and horses are the species most used in leisure while cattle are the main animal used in tract. Local breeds contribute the greatest part of domestic production. Most animal products are consumed locally but they are not enough to satisfy local demand. There is main and growing dependence on imports of animal products due the increase in demand and the inability of local production to meet this growing demand. It is not expected that the levels of local production will change in the near future in view of

the limited natural resources, especially water and land suitable for growing fodders, in addition to climatic conditions.

Live animals are marketed in local traditional open markets through auctions. The locations of these markets are not expected to impact the utilization of AnGR.

In the last ten years, very little changes took place in the relative contribution of the low-input production system to food security, while the contribution of medium-input systems has noticeably increased in cattle, sheep, goats and poultry. However, the contribution of high-input systems greatly increased in poultry and to some extent in cattle and camels. These changes are due to many factors, most important of which are improved veterinary care, growing demand on animal products, availability of financial facilities, improved technical and extension services, enhanced awareness among producers and consumers and increase in purchase power due to increase in income.

Generally, no significant changes are noticed in the type and diversity of products in the last ten years. The improvement of the infrastructure as a result of the well-intended government policies (encouraging the private sector to invest and providing technical support) contributed to the positive development that took place in production systems.

Natural conditions and the adherence to traditional means in production in addition to the severe shortage in feed stuff are among the important factors affecting productivity and efficiency of the main livestock production systems. Among the most important means to overcome these handicaps are developing the traditional systems, improving management and production systems, conducting research to improve productivity, training and workforce rehabilitation and trying to find less expensive feed stuffs through the use of local material and agricultural and fish byproducts.

1.4 Biodiversity

1.4.1 Biodiversity information

The Ministry of Agriculture and Fisheries (MOAF) conducted an animal census in 1982 and again in a comprehensive agricultural census in 1993. The 1993 census included statistics about different species (cattle, sheep, goats, poultry and camels) and their numbers, gender, age structure, production system, herd/flock structure and geographical distribution but the census included nothing on number of breeds and their characteristics. Thus, there is no information system for the domestic animal diversity in the Sultanate.

Veterinary Research Center of MOAF keeps records on endemic diseases affecting livestock, means of treatment and protection, integrated programs for protection and diagnostic and vaccination services. Animal Production research Stations conduct research on cattle, sheep, goats to investigate the performance of the young at different ages, reproduction, mortality, fertility, conversion rate using different feed stuffs and the utilization of agricultural byproducts. There exist data on individual performance of mature males of the local breeds. There are also study results on the adaptation of exotic breeds, comparisons between crosses between local breeds and exotic breeds with local breeds for hybrid vigor evaluation, and continued selection in local breeds. A basic survey was carried out to estimate number of cattle, sheep, and goats but the survey did

not take breed in consideration. No studies have been carried out on genetic distances, molecular characterization or breed market values.

MOAF carries out research to improve the productivity of local sheep and goat breeds through selection. Genetic evaluation and performance recording have been done for some local sheep and goat breeds and their crosses.

It is worth mentioning that there are some goat populations in rural and mountain areas that have not been characterized or identified despite their widespread use in these areas. These populations have distinct phenotypic and productive characteristics which imply that they could be distinct breeds, hence the importance of the need for characterization in the identification of these populations.

Basic survey was done for local camels but without any characterization or genetic improvement. MOAF keeps records on number of camels and their distribution according to regions and different age classes. The General Directorate for Camels in the Sultan's Court conducts research on camel diseases especially infectious, internal and external parasites, feeding, husbandry and rearing of the young. The Directorate has also got a breed improvement center using modern techniques in reproduction like artificial insemination, embryo transfer and semen examination and evaluation.

There are no detailed studies on horses and asses in view of their limited use. There exist adequate statistics on poultry as far as numbers and capacity of each commercial farm are concerned. However, there are no research or scientific programs for breeding or production of local breeds except some descriptive studies in animal production stations. No statistics exist on rabbit nor are there any studies on their breeding and management.

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

1.4.2 Assessing the state of biodiversity in Animal Genetic Resources (AnGR)

a. Cattle

Local breeds:

Baladi (meaning local in Arabic)

Baladi cattle are light brown with medium size, mature animals weighing about 250 kg. It is found in the northern part of the country and raised under traditional system in backyards and farms. The breed is widely used for meat and milk production.

Zufari

Zufari cattle are dark brown with an average boy weight of 250 kg. The breed is found in the southern part of the Sultanate and raised under stationary grazing system. The breed is widely used for meat and milk production.

Introduced breeds

Jersey

The breed is kept only in experimental stations and some private farms under high-input production systems. It is also used for crossing with Baladi cattle in an artificial insemination program to enhance milk production.

Friesian

It is present in specialized dairy farms and a few other farms. The breed is raised under high-input production system for the production of milk and meat.

b. Goats

Local breeds:

Albatinah

Colors common in this breed are dark brown, light brown and black with white spots in the face, belly, and lower limbs. The breed is of medium size reaching 33 kg at maturity. Body is covered with long coarse hair. Legs are short and thick, head is of medium size with somewhat elongated face. It has a straight nose and middle-size ears. Both males and females carry horns. The breed is widely used for meat production and is raised under medium-input production system.

Aljabal Alakhdar (Green Mountain)

Common color is brown. Average mature body weight is 36 kg. Body is covered with soft hair of moderate length. Legs are long and head elongated and of medium size. Nose is curved and ears are of medium size. Legs are moderately long. Both males and females have horns. Tail is short and lifted upward. This breed lives in the valleys and plains of the Interior Region and at the foot of the hills at an altitude of 2800 – 3000 m above sea level. The breed is widely used for meat production. Most of its population is concentrated in the Green Mountain and in the Interior Region and is mainly raised under medium-input production system.

Zufari

Common color is white with other occasional colors as black, dark brown, light brown and a mix of colors. It has a small body covered with short soft hair and weighing an average of about 26 kg at maturity. Legs are short and fine. Head is relatively small with some elongation. Nose is straight and ears are small and erected upward. Both males and females have horns. Tail is long and erected upward. The Zufari breed is found in the Southern Region of the Sultanate in plains and the mountain areas of Zufar governorate. The breed is raised under medium-input system and is widely used for meat and milk production.

Sahrawi (Desert)

This breed is found in the plains and valleys all over the Sultanate. It is characterized by its solid black colored body with brown stripes around the neck and the belly. Head is small and both sexes have horns. Legs are fine with medium length and ears are also of medium length. There have not been studies on this breed either for characterization or performance evaluation.

In addition to the above goat breeds, there are unidentified local breeds utilized by producers which have good productive traits, i.e. milk production and high twinning rate, but no studies have been carried out on them.

Introduced breeds

There are two exotic goat breeds, Anglonubian and Damascus (Shami), whose use is in experiment stations and few producers only.

c. Sheep

Local breeds

Omani

Common color is black but a few sheep are white and brown. Body size is medium to large with an average mature weight of 34 kg. Body is covered with short coarse wool. Legs are fine and medium in length. Head is small with slightly elongated face. Nose is curved while neck is of medium length without any markings. Ears are of medium length and the udder of medium size with teats varying in length. Males carry horns while females do not. Tail is short and thick and always hangs down. The breed is found in the north of the Sultanate and raised under medium-input production system and widely used for meat production.

Zufari

White in color with short legs. The breed is found in Zufar and used on a small scale to produce milk and meat under medium-input production system.

Introduced breeds

There are two imported sheep breeds, Chios and Najdi, whose presence is limited to experimental stations.

d. Camels

Local breeds:

There are no accurate surveys on camel breeds but Omani camels are considered as true Arabian camels. They are all one-humped. There are obvious features for and differences among different camel populations according to which and to other local knowledge they are characterized into the following groups.

Samha.

Common color is dark brown. It is originated in the Interior Region and considered a truly race camel. The group is spread allover the Sultanate and usually raised under high-input production system

Musiha

Usually of golden color but yellow in some cases. It is spread allover the Sultanate and originated in Albatinah. These camels are raised under high-input production system.

Fariha

Large in size and color ranges from blond to yellow. It is originated in the Eastern Region but spread allover the Sultanate. It is used for race and raised under high-input production system.

Khumaisa

Large in size and color is mainly blond. It is originated in the Eastern Region and has been used on a large scale in the past for riding but is used now for racing and milk production.

Khiwara

Large in size and dark brown to black in color. It is spread in different parts of the sultanate, used for riding and racing and raised under high-input production system.

Ramli

Dark brown, large in size with tall legs. Females are characterized by large udder. It is found in the south of the sultanate, widely used for milk production and raised under medium-input production system.

Khuzami

Light brown, large in size with tall legs. It is found in the southern part of the country. The group is widely used for milk production and raised under medium-input production system.

Jabali

Brown with short legs and smaller than Ramli and Khuzami. It is found in the mountainous areas in the south of the sultanate. Animal are raised under low-input production system for meat and milk production.

e. Horses

Horses are usually used for leisure with little use in agriculture. They are not raised on a large scale in the Sultanate. Only few people keep horses and thus there are no field surveys about them

f. Poultry

Local poultry stocks are found in rural areas and raised in households and farms in small numbers. Local poultry is used for home consumption and contributes to some extent to family income. Local poultry is characterized by being adapted to hot weather conditions, disease resistant and show low mortality. Local chickens have medium-length legs with single serrated comb. Plumage color ranges from black to brown to white. The local chicken has a very low production, probably because it is raised under traditional system with inadequate inputs. Average daily growth rate is 75-90 g¹; body weight at 20 weeks of age 1.3 kg, egg production 75-80 eggs per year with an average egg weight of 35-45 g. Egg shell is usually white. There exists no information on local chickens in the Sultanate but there is some information on commercial chicken production which uses exotic stocks.

Generally speaking, while there is lack of detailed surveys on the number and distribution of livestock breeds, it is noticed that their numbers are increasing in a normal way which indicates that these breeds are not endangered. However, crossing with exotic breeds in cattle is expected to impact local cattle breeds in the long run.

There exist no wild relatives of domesticated species except rabbits which play no role in food supply in the Sultanate. There are feral asses in the north of the Sultanate originating from citizens abandoning their animals because of lack of interest and the loss of the ass economic utility.

¹ Translator's comment: this is considered too high for such a chicken, even high for specialized poultry.

1.5 Assessing the state of utilization of AnGR

1.5.1 Utilization of AnGR

Main species used in the Sultanate to meet societal needs of animal products are cattle, sheep, goats, camels and poultry. Local breeds represent the great majority of the breeds in these species. Introduced breeds are mainly used in dairy cattle and chicken commercial farms.

There is no accurate information on breed distribution according to production systems and demographic structure due to lack of related surveys. However, there exists some information regarding exotic breeds utilized under high-input production systems in commercial firms.

There are legislations that regulate the utilization of AnGR and their management in what concerns veterinary quarantine and livestock entry to the country. Also, there are legislations dealing with grazing land and the management of the environment. Legislations of grazing lands and of animal wealth management are considered the main themes in legislations regarding the utilization of AnGR. There are, also policies in place regarding extension service and training. There are no specific regulations that deal with the formation and operation of farmers' coops but the prevailing codes are those based on traditions for the utilization of AnGR and benefit-sharing in a general way, especially what pertains to grazing lands.

It is to be noticed that AnGR utilization is among the national priorities in improving food production. Thus, the government is targeting the genetic improvement of some productive traits through crossing with introduced high performing breeds as in cattle or by selection as the case with sheep and goats. Also, the use of exotic stocks has led to significant increase in poultry meat and egg production but under the high-input production system these stocks require to overcome unfavorable environmental conditions in the Sultanate.

It is worth mentioning that products from local breeds are preferred to those from the exotics, locally and for export, and command high market value. The contribution of local breeds of sheep, goats and cattle to the domestic meat production excels that of the introduced breeds but this contribution meets only small part of the national needs due to their small numbers. However, the situation is different for chickens, where the ever imported stocks in the commercial farms contribute the greatest portion of the domestic production of chicken meat and eggs. However, the local chicken contributes very little to meat supply due to its low productivity and the traditional production systems it is raised under.

Livestock breeding in the Sultanate takes many forms according to the species. Breeding of local chickens has no clear system and in many instances the breeder finds himself obliged to cross with exotics. Similar situation exists with local cattle breeds where crossing with exotics is continually practiced through artificial insemination. However, the situation for sheep and goats is different where producers are keen to stay with one breed in most cases. However, more than one breed are sometimes kept under stationary systems in the farms but crossing is not practiced except in very limited cases as producers prefer local breeds and are keen to keep it pure.

Stock replacements usually take place from within the herd/flock and producers do not bring in breeding animals outside their herds/flocks except in cases where they want to expand their herds/flocks. It is clear that breeders need advice as regards replacement to avoid genetic problems resulting from wrong replacement practices which could negatively impact their herds/flocks. There is also a need to review main breeding systems followed in research stations and farms and to introduce sustainability measures.

Modern techniques in producer's herds are used in crossing local cows, baladi, in the northern parts of the country with Jersey semen through artificial insemination to increase their milk production. However, no evaluation of this program has been conducted to assess the extent of improvement in milk production, change in milk quality and to what relates to adaptation to diseases and parasites and productive life.

There is no performance recording at the producer's level in any species. Producers depend on their local and indigenous experience which contributes greatly to the maintenance of local breeds and the realization of good productivity.

Animal products are greatly affected by international policies, especially those of commercial and health nature. Local animal products face tough competition from imports. Local products are higher priced than the imported because of environmental and weather conditions of the Sultanate and the high cost of feed stuffs.

1.5.2 Development of AnGR

The government adopts research for the genetic improvement of local breeds to enhance their contribution in meeting future societal needs. Private sector companies also contribute to the development of AnGR through bringing in exotic breeds and crossing the local breeds on a small scale.

The development of AnGR is negatively, but temporarily, impacted by some regulations and legislations related to land use by agricultural-investment projects and the environment ,especially water resources, in relation to production capacity of these projects. However, these regulations and legislations are of beneficial impact in the long run. The development of AnGR is regulated through a number of legislations dealing with crossing local breeds with exotics.

There are policies emphasizing the role of women in development as they represent about 32% of the permanent agricultural labor force. For this purpose, a special agency has been created in MOAF whose function includes extension and development programs for the rural woman in the livestock sector and the supervision of these programs to enhance her role in the utilization and development of AnGR. These programs also include making available investment facilities to commercial project like dairy and poultry projects. This has led to the enhancement of the woman's role in food security. It is noticeable that the development of AnGR occupies great importance in the country strategy for food production to meet the local demand but aspects of production, feeding and veterinary care receive more attention than activities related to the development of the genetics of the livestock. This is obvious from what has been achieved in the last few years where the government adopted ambitious programs to assist farmers in establishing small production units of sheep, goats and cattle which use modern production techniques to increase production. The government also continuously provides extension services to enhance farmer awareness of modern techniques in animal production and husbandry.

Cattle genetic programs have been limited only to the baladi breed through AI as previously mentioned. There is effort to improve Zufari cattle by selection. Sheep and goat breed improvement program is better organized and scientifically planned and executed in the experiment stations. Advanced tools in genetic evaluation are used like the multi-trait index and genetic evaluation. This program is limited to the main goat breeds of Albatinah, Aljabal Alakhdar and Zufari and the main sheep breed of Omani. This program has produced promising results which have been made use of only on a limited scale through the distribution of improved breeding animals to a limited number of producers. However, there is a number of breeds with no genetic improvement programs despite their contribution to food supply because of lack of surveys needed to collect information on diversity due to lack of funds and manpower.

AI and embryo transfer are used in camels in a breed improvement program but the use of these techniques has been limited only to racing camels. Despite the limited use of this program, it is hoped to expand the use of such techniques on a larger scale for the conservation of local breeds. It is worth mentioning here that the cultural and social inclinations contributed to the establishment of such activities.

In summary, the government plays the main role in the development of AnGR through what it provides of investment facilities, development and extension programs and veterinary care, while the contribution of the private sector is humble.

1.5.3 Major features and critical areas of AnGR conservation and utilization

Opportunities for improving the utilization of AnGR include breed genetic improvement and the development of management and veterinary care programs. In cattle and poultry production, it appears that these opportunities look better for using imported stocks than local breeds. As for sheep and goats, there is a better chance for the improvement through local breed utilization and the development of breed characteristics, than using imported breeds. Local sheep and goat breeds have a great genetic potential for genetic improvement in addition to their preference by the producer and consumer. A bunch of plans and programs are in place for the improvement of AnGR utilization including the enacting of legislations and issuing of regulations related to this endeavor. Genetically improved stocks have been distributed from research centers to producers to multiply improved genetics in a number of sheep and goat breeds. This is accompanied by a package of extension services including extension and training workshops to train producers on genetic improvement methods and production environment required to enhance productivity. Furthermore, the development of breeding methods created a chance for improving the utilization of AnGR and upgrading the level of awareness among producers of the significance of AnGR and their development. In addition, the government offers investment facilities and provides veterinary services to protect animals from epidemics and other diseases which again provide another opportunity for improving the utilization of AnGR.

It is important to refer here to what these policies and trends are doing in activating the role of women in the livestock sector. They offer a good opportunity for improving AnGR utilization and development, especially in cattle and poultry where women play the main role in their husbandry.

There is a good opportunity for the improvement of the utilization of local AnGR in order to diversify and improve their products which the consumer prefers over those from exotic breeds. There is also an opportunity to use agricultural and fish byproducts as feed resources, a recycling which could reduce the cost of inputs and is environment friendly. In fact extension programs have been affected to assist producers in processing animal feeds from locally available agricultural and fish byproducts. On the other hand, there is still a real need to raise the producer awareness of AnGR.

Despite the potentials in developing AnGR, there are obstacles which hinder increasing production and developing AnGR. Example of these obstacles is scarcity of water resources and harsh weather conditions which have led to inadequate feed resources and high feed costs. More of these obstacles are:

- Absence of surveys for the genetic diversity of local breeds, thus not allowing the monitoring of changes that could happen to breeds
- Absence of livestock information system
- Inadequacy of financial resources needed for AnGR development
- Inadequacy of qualified national cadres needed for AnGR development programs
- Scarcity of applied research in livestock and the wide gap between research and application of results
- Little use of technology in breeding strategies, whether at experimentation or producer level
- Absence of a clear strategy to develop markets for local animal products

In the light of this, needs to develop and improve utilization of AnGR include:

- Establishing a livestock information system
- Conducting surveys on AnGR and setting plans for their development
- Encouraging processing of feed stuffs from agricultural and fish byproducts to help narrow the feed gap
- Raising the efficiency of workers in the livestock sector and setting plans for their rehabilitation and training
- Rehabilitation of research centers and stations to be regional institution for training technical cadres in the field of livestock
- Putting plans for conducting livestock applied research
- Developing mechanisms to follow up performance of the genetically improved stocks distributed to producers by research stations
- Developing markets for local animal products and establishing market outlets

1.5.4 Participation of stakeholders in the development of AnGR

Many agencies contribute to the development and maintenance of AnGR. Of these agencies are the scientific research institutions, other government agencies and private companies. The following is a summary of the role played by each agency.

- The government

The government, in more than anything else, enacts legislation and issues regulations related to the development and maintenance of AnGR. The government also

carries out AnGR development programs like the national selection, crossing and AI programs. Furthermore, the government contributes greatly to structure development (infrastructure) and capacity building through the national university graduates and missions sent abroad. The government contributes in the usual extension and support services.

Local breeds and breeds of foreign origin but produced in the country are more appreciated in the public sector than foreign breeds.

- Breeders Associations

In the Sultanate, there are professional gatherings for those who work in the same field or production system, e.g. low-input production systems, medium-input production systems and high-input production systems. These gatherings do not directly get involved in the legislation process or preparation of AnGR development programs but they are usually consulted within the framework of the prevailing traditions. These groups highly appreciate locally adapted breeds or breeds imported from neighboring countries.

- Private companies

Private companies usually participate in animal production, infrastructure and human resources activities but do not directly deal with legislations concerning AnGR utilization. These companies prefer high performing breeds over locally adapted breeds or those imported from neighboring countries.

- The University and Research institutions

There are a number of agricultural research centers that belong to MOAF and one university, Sultan Qabous, which includes a faculty of agriculture and marine sciences responsible for academic training and conducts some agricultural research, both plant and animal production. The University does not participate directly in the legislation processes related to AnGR. However, experts and professors are consulted through joint committees. The limited contribution of the University in extension service is carried out in coordination with MOAF. The University plays an important role in putting out graduates technically skilled in the development of livestock. The University and research institutions contribute significantly to AnGR development through their activities in the animal production field. These institutions concentrate mainly on breeds adapted to local conditions and foreign breeds produced in the country without totally ignoring exotic breeds and the role they play especially in poultry and dairy production.

II. ANALYZING THE CHANGING DEMANDS ON NATIONAL LIVESTOCK PRODUCTION

2.1 Analyzing the Changing Demands on National Livestock Production

Demand on animal products has increased lately due to population growth, increase in income and health awareness and the change in the way of living in general. This increased demand included red meat, poultry meat, eggs and milk and had a marked effect on livestock policies, strategies, programs, production systems and management.

It is noticed that the effect of increased demand on animal products was reflected on the government policies and strategies whereby it encouraged projects on fattening, milk production, and poultry production through granting easy loans and making available different services needed for such new projects like conducting feasibility studies, continually raising awareness, and conducting research with the objective to maintain and develop AnGR. Also, market development and creating market outlets for quality animal products and supporting industry have been among the government policies and strategies in responding to the increased demand on these products. Legislations enacted by the government for the protection of livestock and improving the producer standard of living have encouraged the investment in livestock projects.

The increase in demand on animal products has impacted animal production systems by increasing high-input systems, especially in dairy and poultry production. Also farmers expanding their fodder-cultivated area, expanding processed feed industry and establishing feed mills based on local material (agricultural and fish) were mainly a result of this increased demand. However, the great expansion in fodder-cultivated areas resulted in the depletion of the limited strategic aquifer and the lowering of the quality of its water. This is considered a real challenge facing the expansion in livestock projects.

The increase in demand on animal products has raised the awareness among producers of the importance of effective resource management through the use of high performing breeds and the application of modern breeding methods like selection, crossbreeding, veterinary care and the employment of qualified professions.

2.2 Analyzing future trends

A priority in enforcing these positive tends in the livestock industry, must be to conserve and develop high producing local breeds through knowing them better, evaluating their productive characteristics and making plans for improving their performance through developed techniques as genetic selection, adopting results of applied research and passing legislations needed to protect them. Also more applied research is needed in the use alternative feed stuffs and utilizing agricultural and fish byproducts in feed processing. Training and encouraging young national to join the field of AnGR development and giving a special priority to create more market outlets for animal products, locally and for export, are among important factors impacting the future development of the livestock industry in the Sultanate.

III. REVIEWING THE STATE OF NATIONAL CAPACITY BUILDING REQUIREMENTS

3.1 Institutional Structure

Administrative structure is the main frame through which policies, future plans and legislations and regulations in both government and the private sector are made. At present, this structure is non-central where the execution of plans and programs is carried out by the General Directorates and offices in the agricultural regions which link with agricultural development centers that are in direct contact with producers. Thus the administrative structure is considered appropriate and expected to continue as it is for the foreseeable future. The role of public sector is focused on education, research, extension services and policy making.

The private sector, represented by the traditional livestock producers and specialized commercial companies, is considered as the main component in the institutional structure for AnGR in the Sultanate. There are no organizations or institutions that look after the organization of AnGR and that is why the presence of such NGO's looking after livestock producers will be beneficial to this sector.

There is close collaboration between the Sultanate and regional and international organizations, among which are Arab Organization for Agricultural Development (AOAD) and United Nation Food and Agriculture Organization (FAO). AOAD assists in capacity building in the field of training, providing technical advice and participate in establishing large livestock projects and disease control. FAO assists in disease control and providing technical advice in livestock disease control and livestock development. These services are provided to the private sector through MOAF.

There is also close cooperation with countries of the Gulf Cooperation Council in the area of livestock protection, disease control and the establishment of joint private sector production and marketing projects.

Human resources managing AnGR are the livestock producers and their families and expatriate labor. These groups lack the knowledge of modern breeding/production and thus they need rehabilitation to be able play a more effective role in the development of AnGR. However, lately there has been reluctance among the nationals to work in the agricultural sector. This and the temporary nature of the expatriate labor represent are a real bottleneck in efforts to improve livestock performance.

There exists information on the owners of livestock holdings and statistics on different animal species and their distribution but not on performance. The government is trying to close this information gap through conducting agricultural censuses, upgrading the efficiency of research stations, animal extension and training and documenting indigenous knowledge.

The State provides education for cadres responsible for the planning and execution of development projects in the livestock sector through the University, institutes, training centers and experiment station administration. The State also enacts legislations regulating the utilization, development and conservation of AnGR in consultation with the private sector. At present these legislations are considered effective.

3.2 Infrastructure

AnGR in the sultanate are composed of the local breeds and few imported breeds which at present do not impact the genetics of the local breeds. Thus all plans relating to the development of and maintenance of AnGR in their natural environments are considered as national strategy. In the last few years, the government has established experiment stations to conduct intensive programs to genetically improve performance through selection to sustain the purity of local breeds especially in goats, sheep and camels. Also, legislations have been enacted to regulate the export of animals of local breeds. The government is raising the awareness among producers of the importance of these local breeds and the enforcement of their desired characteristics like adaptation to local weather and drought conditions, lack of feed and disease resistance. AnGR are contributing to the national income because of what the government provides of services like veterinary care, maintenance of natural grazing lands and providing good environment for the local and export market. There are a well developed communication and road networks and financial institutions. Establishment of experiment stations and service centers and the issuance of legislations that regulate the export and import of AnGR in addition to extension and awareness programs and the maintenance of natural pasture are considered among the most important activities for the maintenance of AnGR in their natural environments. The infrastructure includes the following:

3.2.1 Quarantines, veterinary clinics and laboratories

Veterinary quarantines are distributed over all water, air and land entry points in the Sultanate as a first defense line against epidemics entering the Sultanate. There is one central veterinary laboratory in Muscat and a veterinary hospital in Zufar in addition to 57 governmental and 41 private veterinary clinics. These clinics provide diagnostic, treatment and prophylactic services in addition to conducting surveys on endemic and epidemic diseases and evaluating the efficacy of vaccines used. All these types of diseases are under control and some have actually been eradicated.

3.2.2 Experimental stations

These include experiment stations and centers that belong to MOAF and others that belong to the University of Sultan Qaboos. There is also the Breed Improvement Center which belongs to the Sultan's Court that is concerned with the improvement of local breeds of camels.

3.2.3 Ag development centers

There are 46 agricultural development centers that belong to MOAF distributed all over the Sultanate. Their responsibility is the provision of extension services to raise the awareness among breeders and acquainting them with modern breeding techniques through the execution of packages of extension programs for the development of means and tools of production.

3.2.4 Marketing outlets for animal products

Handling and marketing of animal products are done in the traditional way (auctions in open markets) and there is no marketing system in the rural areas based on modern standards. This present marketing system does not negatively impact local breeds due to their preference by the consumer. The situation is different as far as investment companies are concerned. These companies market their products according to modern marketing systems where they apply measures and specs applicable to their products which open more market opportunities for them like the export market. All products marketed through these companies are mostly from imported breeds except in the case of beef in Zufar.

Among the most important tools used in animal production are those related to growing and transport of fodders and provision of drinking water, in addition to nurseries and hatcheries for poultry production and milking machines of dairy cattle? AI is considered the most widely used technique in developing cattle productivity. However, for sheep and goats selection and crossbreeding techniques are the dominant ones in the genetic improvement. It is noticed that the inadequacy of some elements in the infrastructure has impacted negatively AnGR, e.g. lack of slaughterhouses and parents farms in poultry has slowed down the development in that sector.

IV. IDENTIFYING NATIONAL PRIORITIES FOR THE CONSERVATION AND UTILIZATION OF AnGR

The identification of national priorities for AnGR is interwoven with the different aspects discussed earlier. The establishment of a livestock national information system comes on the top of these priorities as it is considered the cornerstone for assessing needs and making plans for the development of AnGR. This is in addition to conducting AnGR biodiversity surveys and conservation programs. These priorities require a national strategy whose main components are:

- Providing the requirements needed for the maintenance of AnGR of manpower and financial resources
- Making available less expensive feed resources through improving the natural pasture and the utilization of agricultural and fish byproducts
- Improving the management of AnGR
- Stimulating the private sector to invest in the livestock sector and establishing an effective marketing system to counter-effect the competition from imported products
- Developing production means and raising productivity
- Documenting and developing the indigenous knowledge and activate its role in the utilization of AnGR
- Conducting surveys on local breeds and their geographical distribution
- Establishing database for farm animal genetic diversity
- Conducting more research work on breed evaluation , preparation of a national applied research program for livestock and improving the efficiency and spread of extension services
- Closing the gap in skilled manpower

- Creating a new directorate or section for AnGR in the administrative structure of MOAF whose responsibility is the coordination between different activities of the development of AnGR
- The educational institution doing more effort to make producers and workers in the livestock sector more aware of the importance of AnGR
- Making use of the experience and facilities of international organizations related to the maintenance and development of AnGR
- Searching for a mechanism for the participation of all stakeholders to establish policies for AnGR utilization and development
- Formulating a policy for the training and rehabilitation of local staff working in the livestock sector , providing the finance needed for the training and collaborating with regional and international organization in that regard
- Training breeders with academic background in the maintenance and development of AnGR in specialized training institutions
- Providing needed financial resources for the execution of plans and programs for the maintenance of AnGR and improving their utilization and development
- Introducing modern techniques in animal breeding and increasing animal productivity

V. RECOMMENDATIONS FOR ENHANCED INTERNATIONAL CO-OPERATION IN THE FIELD OF FARM ANIMAL BIODIVERSITY

The Sultanate of Oman is an effective member in regional and international organizations related to AnGR. The Sultanate participates in different activities related to this sector carried out by countries of Gulf Cooperation Council, FAO, ACSAD and AOAD and others in the fields of animal health, training, technology transfer and others that are related to animal production. This participation comes through a group of committees formed to coordinate the agreed upon collaborative efforts in policy making and program execution.

It is recommended to strengthen the international collaboration in the field of farm animal biodiversity to realize the following objectives.

- Supporting efforts for the national capacity building in the fields of animal extension, development of infrastructure, research and training
- Fair sharing of responsibilities and benefits of conservation, characterization, evaluation and development of AnGR between the Sultanate and countries of the Gulf Cooperation Council
- Enhancing cooperation between the Sultanate and United Arab Emirates in 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 the two countries
- Promoting collaboration between the Sultanate and countries of Gulf Cooperation Council in developing information systems and communication networks
- Promoting regional collaboration with countries of Gulf Cooperation Council and neighboring countries to control epidemic diseases through a joint strategy to control animal movement and involving other concerned countries

- Securing the cooperation of the Sultanate with international organizations in relation to the observance of international regulations and principles as regards property rights, patents and ethics, to secure the proper international transfer of AnGR and their conservation, ownership and fair exchange and trade
- Securing international cooperation with international organizations for funding necessary for establishing a livestock genebank

VI. OTHER ELEMENTS

6.1 General recommendations

Through the preparation of this report on Oman State of AnGR, the following recommendations may be made.

- Preparing a follow-up mechanism after submitting this report to FAO
- Starting to conduct surveys on farm animal biodiversity in order to provide information required for the preparation of world AnGR database
- Establishing national system for AnGR in the Sultanate
- Evaluating AnGR situation in the Sultanate and identifying the needs and requirements for their maintenance and development
- Establishing a strategy for the development of AnGR and securing funds for carrying out this strategy
- Activating the role of the private sector in AnGR management and creating an engaging relationship between the public and private sectors in this field

6.2 Steps carried out for the preparation of SoW Report

Work on the preparation of this report started after completing the FAO workshop on how to prepare country SoW reports. A work team was established of a group of specialists and offices related to AnGR like research centers, the University and the General Directorate for Planning and Investment in MOAF. The team collected information from research centers and regional General Directorates of Agriculture and Animal Wealth and Fisheries which supervise different livestock development programs. In the light of this, the team completed the forms and tables for the report through a series of meetings. Other agencies related to AnGR were also contacted, but not represented in the preparation team, to obtain information about some species and breeds, their utilization and programs for their development.

Then, a smaller team was selected for writing the draft report making use of the Predefined Tables and Background Questions in the Guidelines for the preparation of SoW. The first draft was reviewed by the whole team and the draft report was amended according to comments made by the committee members to produce the final version

6.3 Attachments

Table of production characteristics of local cattle

Breed	Production trait							
	Mature Body wt., kg	Lactation length, day	Milk production kg	Fertility %	Fat %	Birth wt. kg	Weaning wt., kg	Yearling wt., kg
Zufari	300	190	380	84	5	17.5	85	166
Baladi	<i>no information was provided in the original Arabic text</i>							

Table of production characteristics of local sheep and goats

Breed	Production trait							
	Mother's wt, kg	Fertility %	No. of young	No. weaned	Birth wt.	Wean wt, kg	6 mo wt	
Albatinah	33.3	87	1.22	1.05	3.02	13.9	21.3	
Zufari	25.8	84	1.19	1.07	2.94	12.7	18.4	
Aljabal Alakhdar	36.2	86	1.23	1	3.12	14.5	22.7	
Sahrawi goats	no information available							
Omani sheep	33.9	90	1.29	1.05	2.82	16.4	26.8	
Zufari sheep	no information available							

List of people participating in the preparation of the Report

Nothing was written under this subtitle in the original Report in Arabic