Report on the State of the World Animal Genetic resources (AnGR)


Prepared by

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for

Botswana National Focal Point for the Management of AnGR
Department of Agricultural Research
P/Bag 0033, Gaborone, Botswana
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Cover Page: Tswana heifers on a selection program at Musi Ranch (Dept. of Agricultural Research)
Tswana goat with a kid
Cow being milked in the cattle post
(All pictures by OR Madibela)
ACKNOWLEDGEMENTS

The authors thank Mr Baitsi Podisi for drafting Chapter 3 of the report. Thanks to the various departments and institutions that provided the information on farm animal genetic resources. Special thanks go to the stakeholders who verified and corrected the information. Members of National Advisory Committee on Farm Animal Genetic Resources are acknowledged for their support.
EXEUCTIVE SUMMARY

Botswana has a total surface area of 580 000 km². The national human population is 1.68 million and about 50% of the population reside in the urban area. Human population growth rate is estimated at 2.4% per annum down from 3.5% in the previous decade (1981–1991).

The climate of Botswana is generally described as semi arid to arid and the major constraint on the biological resource base for both animals and plants, is low and erratic rainfall. Rainfall is erratic, both spatially and in its distribution across the season, and occurs between October and April. This type of climate favours domestic and wild animal production and is not suitable for intensive crop production.

The natural vegetation is classified as grass, shrub or tree savannas but among these there are many variations. Half of the total area of natural vegetation is available for the grazing of domestic livestock.

The two major animal farming systems in Botswana are traditional (subsistence) and commercial farming and they operate under different land tenure systems. Traditional farming is practiced in the tribal land where grazing resource is communal whereas commercial farming is found in the leasehold land or freehold fenced farms. The development of boreholes has seen the cattle posts shifting from the hardveld to the sandveld in the western part of the country.

Approximately 86% of the cattle, 97% of the sheep, and 99% of the goats are in the traditional sector. Commercial farmers keep most of the chickens (78%) an indication that the poultry industry has commercialized. The major livestock products are meat, milk and to a lesser extent pelts from Karakul sheep. Other products are hides/skins, manure. Donkeys and horses are used for draft power and recreation. Agriculture contributes 2.5% to the GDP, it directly employs approximately 5997 persons and there are 124 256 farming households. This means that agriculture is a source of income for a significant proportion of the Botswana population. Most of the income from the agriculture sector comes from livestock, mostly beef cattle. The existing structure of the livestock industry has been mainly determined by the climate, government policies and the pattern of land ownership. Support by government to the cattle industry is mainly in extension and research services that contribute to continued export of beef to the European Union.
Major constraints to animal agriculture in Botswana are; erratic rainfall overstocking and poor animal management. The lack of highly developed markets for some species like goats and sheep continues to impede on their productivity. Cattle in the northern part of the country also are not able to access the markets. Lack of long-term research programs and absence of a breeding policy also contribute to the problems.

Research has shown that small-scale arable farmers get negative returns to their investment in arable farming. This indicates that small-scale arable farming is not viable and has no potential to lift people out of poverty. Therefore livestock farming holds the key to the development of the rural economy and has the potential to improve food security in areas where poverty is endemic. However, the distribution of cattle ownership is very skewed and more than 50% of the farming households do not own cattle. Sheep and goats on the other hand are more fairly distributed because over 70% of the farming households own goats but the average flock size is small. This means that development of small stock industry has the potential to benefit majority of families.

The increased demand for livestock products will result in the development of more intensive systems of animal production. Due to the challenges of globalization, farmers are likely to shift to large-scale production systems to take advantage of economies of scale and small-scale farmers will find it difficult to stay competitive. This trend is already showing through the development of the National Master Plan for Arable Agriculture and Dairy Development (NAMPAADD) and the promotion of the fencing component of National Policy for Agricultural Development. Therefore this calls for the development of long term strategies for the development of animal agriculture with priority in training, research issues, policy and legal matters. The establishment of relevant institutions that monitor livestock performance recording as well as the operations of breed societies is vital.

Risk factors in the Traditional system include drought, disease, and poor infrastructure development, lack of access to capital and unavailability of labour. The risk factor of drought is less in Commercial production system because of judicious feed management. When the drought is severe commercial farmers reduce stocking rate unlike subsistence farmers who hang on to their animals for sentimental reasons until the animals starve to death. Both commercial and traditional farms are equally exposed to the risk of economical disease such as foot and mouth disease.
Limited research has been done on very few ruminant species (sheep, goats and mainly cattle) and therefore limited information is available on these species in Botswana. The Department of Agricultural Research conducted research on comparison of indigenous breeds of cattle and smallstock with some of the exotic breeds and their crossbreds. Most of the evaluations were done on-station and they covered reproductive performance, growth, survival and overall productivity. No molecular characterization studies have been done yet. Nothing has been done on most of the avian species, but chickens and ostriches have now become economically important for the country. Research on mono-gastrics should be give priority in order to contribute to the diversification policy and requires capacity building in terms of trained personnel to support the demands of this growing industry.

Surveys on livestock population only estimates animal numbers and covers cattle, sheep, goats, pigs, donkeys, horses and chickens. The information doesn’t reflect anything on the type of breeds kept, limiting decision making on the use of breeds within the country. The Domestic Animal Diversity Information System (DAD-IS) contains information on breeds, but it is not adequate and the database is not updated as frequently as the users would like it to be. Botswana has no programme to monitor the breeds that are at risk. Record keeping by farmers is limited to a few commercial and institutional farms. Botswana has just started a national Livestock Identification and Traceability System (LITS), which will allow the traceability of beef from the farm to the supermarket in line with the European Union beef, import requirement. This system has potential to be used in collecting information, which can be useful in monitoring breed trends. There is also potential for interfacing it with the DAD-IS.

The beef industry is experiencing a lot of change whereby the indigenous breeds are gradually declining in numbers due to crossbreeding. The uncontrolled breeding is due to the difficulty in controlling breeding in communal areas where fence infrastructure is absent. Most of the farmers tend to upgrade their animals towards their exotic parental breeds because farmers target producing heavier carcasses, which fetch better prices at the Botswana Meat Commission. However breeding for heavy carcasses with continental breeds by small-scale farmers in a drought prone country like Botswana requires support in the form of feed subsidies by government during drought years. This may prove not to be sustainable in the long term.
Data from Ramatlabama Bull Stud and Artificial Insemination Laboratory showed that bull breeds used for AI include indigenous breeds (from the region): Tswana, Tuli, Bosmara, Africander and exotic breeds: Brahman, Simmental, Hereford, South Devon, Santa Gertrudis, Friesian, Charolais, Pinzgauer, Sussex, Gilbviech and Jersey. From this data, the use of exotic bull breeds in Botswana is significantly higher than that of indigenous bull breeds.

Tswana and the Boer goats are the major goat breeds and Tswana and Dorper are major sheep breeds used within the Botswana. However a significant number of farmers are increasingly using the Dorper sheep and Boer goats, respectively, for crossbreeding and pure breeding. Under local conditions, the indigenous Tswana sheep and goats outperform exotic breeds in terms of survival. Due to the recognized potential of the Tswana goats and sheep in terms of adaptability under the local production environment, the Department of Agricultural Research initiated an on-station selection program to improve the breed.

Botswana has a very low number of pigs owing to low consumption of pork around the country. The number of indigenous (Tswana) pigs is not known but they are very few and are declining in number as most of the farmers keep exotic commercial breeds.

There is lack of information on the breeds of equines within the country. The breeds of donkeys are particularly poorly understood. Horses and donkeys are used for transport in the rural areas. The value of donkeys may appreciate with the recent proposal to slaughter them for export.

Botswana has one breed of dromedary camels, which was introduced into the country from South West Africa (Namibia) in 1921 during the colonial era. This herd is made up of less than 100 breeding females and is listed as critical in the World Watch List for Domestic Animal Diversity.

The population of indigenous chickens was estimated at 3.5 million. Their contribution to human nutrition (meat and eggs) and economic well being of the rural communities is vital. There exist strains of naked neck, rumples, feathered crest, feathered legs and fizzle-feathered genotypes within the population. Their potential use in providing organic white meat remains underutilized due to lack of inputs and lack of information by farmers. Promotion of research on improved management of indigenous breeds of poultry is worth undertaking. The three commercial broiler hybrids used are Ross, Cobb 500 and Indian River. Hyline Silver Brown and Hyline Brown are the ones used for commercial egg production.
The chicken industry has been growing fairly fast and has managed to meet most of the local demand for eggs and broiler meat.

Ostrich farming is at a fledgling stage and is expected to grow especially with the newly constructed abattoir, which is targeting the export market. The initial birds reared in Botswana were captured from the wild and their later progeny are sold to new ostrich farmers.

There is no specific legislation that prevents the use of certain animal breeds except for ostriches. Restriction on the use of certain species in some ecological areas or production systems also does not exist. The country has no legislation or policy to protect and use indigenous knowledge and practices relevant to the use of animal genetic resources. In addition there is no research to document indigenous knowledge and practices in management of animal genetic resources. It is recommended that concerted efforts be made to fill this information gap so that appropriate action is taken to protect the knowledge and also use it to develop management systems for animal genetic resources.

The use and collection of semen and embryos, registration and control of inseminators, monitoring of performance recording scheme, and the studbook needs urgent consideration.

The current Registration of Livestock Act: (cap 36:04) is outdated. The act requires farmers in Botswana to register breed societies in South Africa and as a result the indigenous breeds such as Tswana cattle will not get registered because it does not exist in South Africa.

There is limited capacity at national level to carry out a comprehensive straight breeding programmes for all livestock species. In general there are few animal breeders with postgraduate qualifications. There are also no laboratories to support research in biotechnology and there are a few researchers with postgraduate qualifications in biotechnology. It is expected that advancements in biotechnology such as gene marking, genetic modification and embryo sexing will speed up genetic development and development of new breeds in all species. There are threats of intellectual property rights that may hinder access to certain breeds and animal welfare conditions may prohibit intensive production systems such as found in poultry production.

As the demand for organic beef increases Tswana and Tuli cattle stand a good chance of being cattle of choice because they are hardy and survive on the range. The same applies to Tswana goats and sheep including the Damara sheep. The adapted ostriches will be used more as the
ostrich industry grows. There are opportunities that donkey meat can be exported to Europe and therefore the donkeys may be used more for meat production.

Tswana cattle are under utilized due to lack of promotion of information on their productivity. The rest of the species are not utilized because farmers do not know how to manage them and lack information. There are also constraints to the genetic improvement of the above-mentioned species because there are few animal breeders and inadequate facilities.

Botswana has conservation initiative for Tswana cattle, sheep and goats. The objective of is to select within the breeds for economic traits, better growth, good mothering ability and better reproduction and reduced mortality. It is assumed that commercialisation of these breeds will lead to their increased demand and thus prevent their extinction. However the selection within the breed may limit the diversity within the breed and as a result the breeds may loose some of their characteristics that are not seen as important at the moment. Farmers do not participate in this initiative because selection is within a closed nucleus system.

As for other species, animals will be placed in conservation farm for research and education. The danger of the conservation farm is that natural disasters such as floods or disease outbreaks may result in drastic losses of animals. In addition a laboratory (ex situ conservation) for cryo-conservation of semen, embryos, ova, cells and DNA material will be established. The advantage of the latter system is that it saves space and can retain the material for a long time. In addition lost genotypes may be reconstituted if their genetic make up is known. This is an important system for conservation purposes and may facilitate easy exchange of genetic resources and it serves as a gene bank.

The government only funds conservation projects that are carried out through its various departments. There are limited funds to fund conservation projects initiated by farmers, companies and communities. The major disincentive for conservation projects is that they are in most cases not profitable in the short run, so most of the private companies see no need to invest in them. The private sector (such as Botswana Meat Commission) can be induced to play a major role in the conservation of animal genetic resources through tax rebates and creation of funding mechanisms that are open to the private sector. The creation of legislation that protects the rights of a breed developer is important.
Tswana pigs are confined to the areas of Ramotswa, Tlokweng and Kgatleng districts because these people have a long history of keeping pigs and they eat pig meat. At the same time it has been observed that some religious denominations prohibit their members from eating pig meat.

The Ministry of Agriculture has two major Departments that deal with animal genetic resources, namely Animal Health and Production and Agricultural Research. The Department of Animal Health and Production is responsible for animal production extension and for disease control. The Department of Agricultural Research is responsible for animal production research however research in this Department has been restricted to cattle (beef and dairy), sheep and goats. There are plans to introduce research on other species such as chickens, and ostriches. The Botswana Meat Commission is a parastatal that provides a market for beef cattle and to a lesser extent sheep and goats. The Botswana College of Agriculture is responsible for training and also carries out research. Schools and vocational institutions and demonstration centers also keep animal genetic resources for demonstration and educational purposes. There are farmers associations such as Botswana Dairy Association, Botswana Poultry Association, Small Stock Breeders Association of Botswana, Botswana Pig Producers Association that promote the use and in some cases conservation of animal genetic resources. Conservation of natural resources is the responsibility of the National Conservation Strategy Agency (NCSA), which falls under the Ministry of Environment, Wildlife and Tourism. The NCSA is the focal point for the Convention on Biological Diversity (CDB). The major limitation with this institutional set up is lack of coordination and networking. Farmers in most cases are not organized and as a result fail to contribute meaningfully in policy formulations. The establishment of the National Advisory Committee on Farm Animal Genetic Resources that consists of major stakeholders such as farmers, government officials and major parastatals may help improve the situation. It is mainly to help the government come up with policies and regulations that can assist the coordination of the use of animal genetic resources.

Copyright and Neighbouring Rights Act: Act No 8 of 2000 does not extend to livestock and Industrial Property Act: No 14 of 1996 is not specific to livestock and as a result there is concern that genetic resources are not well protected because in some countries livestock breeds can be patented. However it must be admitted that patenting breeds may deny small farmers access to breeds of livestock that are well suited to their environment because they cannot afford the price. At the same time there is need to reward innovation so the country must come up with a
legislation that protects breed developers. However care must be taken to protect farmers’ right to access the breeds that are indigenous or derived from the indigenous animals found in their area.

The use of biotechnology in animal science has created opportunities for developments of genetically modified animals but there are also threats that this innovation may end up producing livestock products that are not safe for human consumption. There are also ethical issues that must be considered such as whether it is right to introduce human genes in livestock. At the moment there is no legislation regulating the use and production of genetically modified livestock in Botswana and as globalization intensifies the country will soon find itself confronted by these issues.

Women participate more in poultry farming and in small stock but to a less extend in cattle farming. There is a need to develop a strategy for involving women in beef farming because it can improve their standard of living.
RECOMMENDATIONS

Recommendation 1. A follow up project to the current FAO/SADC project should be developed to address issues of long-term training on animal breeding, molecular biology and also in the establishment of facilities such as biotechnology laboratories and regional gene banks similar to the plant gene bank. The member countries must create a mechanism for exchanging information for breeds that are common and sharing of facilities. They should also develop common legislation to regulate exchange of genetic material.

Recommendation 2. There is a need to build the capacity of farmer organizations to enable them to effectively contribute to policy formulation.

Recommendation 3. It also emphasized that a good policy is informed by good technical information and thus there is need to do more research on animal genetic resources to gather information on the state of animal genetic resources, their characteristics, and the indigenous knowledge about their management and use.

Recommendation 4. The private sector (such as Botswana Meat Commission) can be induced to play a major role in the conservation of animal genetic resources through tax rebates and creation of funding mechanisms that are open to the private sector. The creation of legislation that protects the rights of a breed developer is important.

Recommendation 5. There is a need to reward innovation so there should be a legislation that protects scientists but at the same time care must be taken to protect farmers’ right to access breeds that are indigenous or derived from the indigenous animals found in their area.

Recommendation 6. There is a need for legislation that deals with genetically modified animals.

Recommendation 7. There is a need to develop a strategy for involving women and youth in animal agriculture.

Recommendation 8. There is a need for the development of long term strategies for the development of animal agriculture with priority in training, research issues, policy and legal matters.

Recommendation 9. There should be farmer education on conservation of farm animal genetic resources
Recommendation 10. The establishment of relevant institutions that monitor livestock performance recording and the existence of breed societies are important.

Recommendation 11. Top on the list is specialized training on molecular biology, which will help the genetic identification of the breeds found in this country. This is long-term training to masters or doctorate level.

Recommendation 12. It is recommended that the country put an information and communication strategy to promote and create awareness on animal genetic resources and their conservation. Information must be disseminated through popular press such as newsletters or government magazines such as Agrinews and the Internet.

Recommendation 13. Local databases on existing animal genetic resources must be developed to document indigenous knowledge and population trends of local breeds. FAO may assist by short-term attachments of experts to help the country develop its database.

Recommendation 14. There should be concerted efforts to develop the sheep and goats industry. This involves creating products and markets. This industry has the potential help to reduce poverty in the rural areas.

Recommendation 15. All under-utilised livestock such as indigenous chicken including game should be developed to contribute meaningfully to food and agriculture.

Recommendation 16. Product branding should be undertaken to promote meat from indigenous animals, which advertises traits such flavour, tenderness and other carcass characteristics.

Recommendation 17. The national Livestock Identification and Traceability System (LITS) should be used to collect other information, which is valuable such as monitoring breed data for research and policy decision-making. There is also potential for interfacing it with the DAD-IS.

Recommendation 17. Agriculture statistics should be produced timely and regularly. Therefore government should strengthen Agriculture Statistics Unit.
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### Acronyms

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<td>AI</td>
<td>Artificial insemination</td>
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<td>APRU</td>
<td>Animal Production Research Unit</td>
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<td>BCA</td>
<td>Botswana College of Agriculture</td>
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<td>BIDPA</td>
<td>Botswana Institute for Development Policy Analysis</td>
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<td>CEDA</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>ILRI</td>
<td>International Livestock Research Institute</td>
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<td>LITS</td>
<td>Livestock Identification and Traceability System</td>
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1. **INTRODUCTION.**

Botswana is a landlocked country at the center of Southern Africa bordered by the Republic of South Africa in the South, Zimbabwe in the East, Zambia in the North and Namibia in the West. Angola is a near neighbour in the North above Caprivi Strip (Map 1: Annex 1). The country is located between latitudes 18°S in the North and 27°S in the South and longitude 20°E in the West and 29°E in the East (See attached Map), and has an altitude of 1000m above sea level. It has a total surface area of 580,000 km². The national human population is 1,68 million and about 50% of the population reside in the urban areas (Central Statistics Office, CSO 2001). According to this report (CSO 2001) human population growth rate is estimated at 2.4% per annum down from 3.5% in the previous decade (1981 –1991).

There are low ranges and isolated rocky hills in some areas but generally the country has topography of seemingly endless savanna rangelands that changes radically in the northwest and the north of the country. In these regions the Okavango River, flows from Angola and forms a large inland delta. There is also the Chobe River, which flows into the Zambezi but was once connected to the Okavango Delta. Ecologically these regions are very distinct from the rest of the country. The climate of Botswana is generally described as semi arid to arid and the major constraint on the biological resource base for both animals and plants, is low and erratic rainfall. The rainfall averages about 700 mm in the North and below 250 mm in the Southern tip. It is erratic, both spatially and in its distribution across the season, and occurs between October and April. In summer, temperature rises to more than 40 °C in some areas resulting in high evapotranspiration. This type of climate favours domestic and wild animal production and is not suitable for intensive crop production. However there are some areas suited to crop farming but they make less than 5% of the land area (National Agricultural Master Plan for Arable Agriculture and Dairy Development, NAMPAADD 2002).

The natural vegetation can be classified as grass, shrub or tree savannas but among these there are many variations as described in the attached vegetation map (Map 2: Annex 2) produced through the FAO Soil Mapping and Advisory Services Project (AG: DP/BOT/85/011) (De Wit P. V., and Nachtergaele F. O., 1990). Small areas of grassland savanna occur at Lake Ngami, around the Okavango Delta and at the Makgadikgadi Pans. Very large areas of bush savanna occupy the
south and southeast of the country and part of the west and central Kgalagadi. Different types of
tree savanna are found in the northern region of the Kgalagadi, in Ngamiland, the hardveld
regions in the east, and the Mopane areas of the northern hardveld. In the Chobe District there is
a dry deciduous forest, while the Okavango Delta exhibits a distinct ecology of savanna and
forests alternating with aquatic grasslands. Half of the total area of natural vegetation is available
for grazing by domestic livestock and wildlife.

Botswana is divided into 10 administrative districts, which offer services such as health,
education, provision of infrastructure and other social programmes. Agriculture development is
the responsibility of the central government but the Ministry of Agriculture has Regional and
District offices across the country. Agricultural Statistics is based on the Regions and districts of
the Department of Crop Production and Forestry (Map 3: Annex 3).

The two major animal farming systems in Botswana are traditional (subsistence) and commercial
farming and they operate under different land tenure systems. Traditional farming is mostly
found in the tribal land where grazing of livestock is communal whereas commercial farming is
found in the leasehold land or fenced freehold land. In theory animals for an individual in the
traditional sector has access to land, but in practice its different. Farmers have cattle posts with
arbitrary borders and one’s animals, together with those of neighbours are confined to that area.
Watering, which in most cases is from wells and boreholes controls animal movement. Herdsmen
also control animal movement. In commercial farming system, the land is fenced, partitioned to
control animal movement, grazing, breeding and to facilitate other management practices. The
development of boreholes has seen the cattle posts shifting from the hardveld to the sandveld in
the western part of the country. Most of the national livestock is kept by traditional farmers and is
found in the communal areas. Approximately 93% of the cattle, 96% of the sheep, and 99% of
the goats are in the traditional sector (CSO 2002). Commercial farmers keep most (78%) of the
commercial chickens (CSO 1999), an indication that the poultry industry has commercialised.
The indigenous chicken, which was estimated to be 3.5 million (Moreki 1997), is still reared as a
backyard activity in the rural areas. There is concern that the communal areas are overstocked
and are continually being degraded. As a result government is now promoting the fencing of
grazing areas to control stocking rates and for farmers to be accountable for the management of
grazing areas.
The major crops are sorghum, maize, millet and pulses. Sorghum is one of the most important cereal crops but the domestic production is inadequate to meet the local demand. The cereal deficit was estimated at 169,280 metric tons for 2001/02 seasons (National Early Warning Unit 2001).

The major livestock products are meat, milk and to a lesser extent pelts from Karakul sheep. Other products are hides/skins and manure. Donkeys and horses are used for draught power and for recreation. Agriculture contributes only 2.5% to the GDP, it directly employs approximately 5997 persons (Bank of Botswana 2001). There are approximately 124,256 farming households (CSO 2002) and out of this 99.6% is within the traditional sector (CSO 2002). This means that agriculture is a source of income for a significant proportion of the population. Most of the income from the agriculture sector comes from livestock, mostly beef cattle. The existing structure of the livestock industry has been mainly determined by the climate, government policies and the pattern of land ownership. Support by government to the cattle industry is mainly in services that contribute to continued export of beef to lucrative markets and the quest to commercialise the livestock sector. These include extension and research services.

Major constraints to animal agriculture are; erratic rainfall leading to low quality and shortage of forage, overstocking leading to degradation of the rangelands. Lack of highly developed infrastructure to serve livestock markets for goats and sheep in the rest of the country and cattle in the northern part of the country hindered contribution of these species to industry. Poor animal management by farmers also contributes to these constraints. Lack of applicable long-term research programs and breeding policy play a part in the scarcity of information on livestock management.

Botswana has achieved food security at national level not through production of cereals but by importing food resources. Most households have to purchase food, mostly cereals, since household production is inadequate to meet the needs of the family. Income comes from employment, remittances, and from agriculture, mostly livestock. It is estimated that 47% of the population is living below poverty datum line (BIDPA, 1997), an indication that there is food insecurity at household level. The government provides basic food to the poor through its Destitute Policy. In addition there are other programmes such as labour-based projects that are
designed to assist poor households to earn income during drought years. Surveys by the Farm Management Section of the Division of Agricultural Planning and Statistics indicated that small scale arable farmers get negative returns to investment in arable farming, an indication that small scale arable farming is not viable and has no potential to lift people out of poverty. Therefore livestock farming holds the key to developing the rural economy and has the potential to improve food security in the rural areas where poverty is endemic. Cattle owned by 55.5% of the farming households (CSO 2002). Goats on the other hand are more fairly distributed because 77.3% of the farming households own goats although the average flock size is small (CSO 2002). Eighty-six percent of the farming households raising goats owns 40 animals or less. This means that the development of the goats industry has the potential of benefiting most of the farming households.

The increase in urbanization resulting from migration from rural to urban areas is associated with movement of potential able-body persons out of agriculture to take advantage of employment opportunities created by other sectors of the economy. Poverty and lack of economic activities in the rural areas is the cause of these trends. It is estimated that 62% of the poor are in rural areas, 14% in urban centers and 24% in urban villages (Botswana Institute for Development Policy Analysis (BIDPA), 1997). There are indications that poverty levels are reducing but at a slow rate of 12% from 1985/86 and 1993/94. According to United Nations Development Programme, Botswana (UNDP) (2002) poverty is worsening in the remote areas of Botswana.

Urbanization has resulted in an increased demand for animal products such as meat, milk, milk products and eggs. The demand for red meat was estimated to grow at about 4-5% per annum by Deloitte and Touche (1996) and was estimated at 25 000 metric tons/year in 1996. Per capita consumption of broiler meat and eggs has been reported to be on the increase (Animal Production Report, 2000). On average there is an increase in expenditure on imported milk and milk products which means that the demand for these commodities has increased (DAHP 2002).

Most rural areas not well serviced with infrastructure such as roads, electricity, and telecommunications. Agricultural production areas need these services as well, but they are sparsely populated and since developments are influenced by population distribution, then they are of less priority. It is only now that government has commissioned a consultancy to develop a strategy for providing infrastructure to agricultural production areas. The drift of able-bodied
people to urban areas has created labour shortage in the agricultural sector, which in the past was
dependent on family labour. The labour shortage is so acute that government has now allowed the
importation of unskilled labour for employment in agricultural enterprises.

The increased demand for livestock products will result in the development of more intensive
systems of animal production. Already there are initiatives to promote urban and peri-urban
agriculture, which is a high input/output production system because production is confined to a
small area. This will promote the use of exotic breeds that are prolific such as hybrid chickens,
exotic dairy breeds, exotic pig breeds and probably feedlot operations for beef cattle. Other
livestock such as rabbits may play a more prominent role because they are well suited to an
intensive production system. On the other hand there are indications that the demand for organic
animal products will increase due to global influences. These will favour extensive livestock
production systems currently used to produce cattle, sheep and goats, and hopefully the use of
well-adapted local breeds will play a prominent role. Due to the challenges of globalization,
farmers are likely to shift to large-scale production systems to take advantage of economies of
scale and small-scale farmers will find it difficult to compete. This trend is already showing
through the development of the NAMPAADD and the promotion of the fencing component of
National Policy for Agricultural Development. NAMPAADD indicated that dairy production is
only viable if 50 or more milking cows are used, each producing at least 4 000 litres of milk per
lactation. The beef industry will shift more to large-scale commercial farms due to the promotion
of fencing under the National Policy for Agricultural Development. Whereas livestock
production will remain important, the challenge will be to increase productivity, promote
sustainable production systems and being competitive in the markets without degrading the
environment. This calls for the development of long term strategies for the development of
animal agriculture prioritizing training, research issues, policy and legal matters and also to
establish relevant institutions that monitor livestock performance recording and the operations of
breed societies.

This report will cover the present situation on the utilization of animal genetic resources under
different production systems, highlight the problems that hinder the development and
conservation of animal genetic resources and suggest solutions to these problems at national,
regional and international level.
2.0 THE STATE OF PRODUCTION SYSTEMS

Agriculture in Botswana is classified as Traditional or Commercial. Rennie et al., 1977 defined these two production systems. Traditional is where animals are managed on unenclosed grazing land. Grazing land is communal but some farmers have drilled boreholes and acquired individual rights to the use of water. Animal management standards are low and it is difficult to introduce practices such as weaning and the controlled use of males (Rennie et al., 1977).

In the commercial system animal rearing is practiced on freehold or leased ranches. Fencing facilitates control of breeding, to separate young stock and to retain standing hay for the dry season feeding. Attention is paid to disease control and mineral supplementation is provided as dicalcium-phosphate lick to combat phosphorous deficiency. Adequate water supply is continuously available within a reasonable distance (Rennie et al., 1977). Management of beef cattle is extensive with only few feedlot operations. However sheep and goats are reared extensively alongside with cattle utilizing natural pasture.

In both these systems animals of significance are cattle, goats, sheep and chickens (CSO 2002). Demand for milk is increasing, for instance in 1991 importation of fresh milk was 4 359 765 and it was 14 501 084 litres in 1996 (DAHP 1997). In 1997 it was 24 110 270 and increased to 49 518 485 litres in 2001 (DAHP 2002). Local breeds of pigs and chicken are reared on extensive basis and scavenge for food. The supply of eggs and poultry meat from local production has increased in recent years (Table 2.1). This reflects the demand for these products, and is due to urbanization as more people have more money to spend on animal products. Per capita consumption of chicken eggs increased from 36 to 62 eggs unit per person per year from 1991 to 2001 while poultry meat has increased from 2.95 to 20 kg per person per year in the same period (DAHP 2001). This demand has created opportunity for the establishment of commercial poultry projects, which were financed by Financial Assistance Policy, even in the rural areas. A new trend is the introduction of ostrich meat for export market, which comes from local wild-farmed birds. Generally donkeys are raised for draught power in the Traditional production system, however recently there is interest in exporting donkey meat.
### Table 2.1 Amount of chicken meat and eggs produced locally from 1991 to 2001

<table>
<thead>
<tr>
<th>Year</th>
<th>Local production</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Meat (tons)</td>
<td>Eggs (million)</td>
</tr>
<tr>
<td>1991</td>
<td>2597</td>
<td>46.4</td>
</tr>
<tr>
<td>1992</td>
<td>5244</td>
<td>61.1</td>
</tr>
<tr>
<td>1993</td>
<td>6155</td>
<td>66.4</td>
</tr>
<tr>
<td>1994</td>
<td>4605</td>
<td>56.4</td>
</tr>
<tr>
<td>1995</td>
<td>7850</td>
<td>56.9</td>
</tr>
<tr>
<td>1996</td>
<td>7722</td>
<td>48.1</td>
</tr>
<tr>
<td>1997</td>
<td>11747</td>
<td>46.6</td>
</tr>
<tr>
<td>1998</td>
<td>15461</td>
<td>59.6</td>
</tr>
<tr>
<td>1999</td>
<td>17219</td>
<td>56.5</td>
</tr>
<tr>
<td>2000</td>
<td>27950</td>
<td>67.5</td>
</tr>
<tr>
<td>2001</td>
<td>32500</td>
<td>186.9</td>
</tr>
</tbody>
</table>

Source: DAHP (2001)

#### 2.1 Primary Animal Production Systems

The primary systems are the Traditional and Commercial Production Systems

##### 2.1.1 Traditional Production System

This production system holds most of the livestock, which comprises of 93.0% cattle, 96% sheep and 99% goats (CSO 2002). Small-scale farmers, who own 40 animals or less, and raise livestock for subsistence dominate this system (Table 2.2). Few large-scale traditional farmers own most of the cattle. Most of the traditional farmers keep most animals species (ie sheep, goats, cattle and chicken). Sheep and goats are normally managed and kept together whereas cattle are managed separately. In certain instance all the three species are raised along side each other. There are specialized Karakul sheep farms in the Kgalagadi area. These are raised for pelt production for export. The farm income from pelt is uncertain because of fluctuations in international markets. The campaign against the use of animal products in the fashion industry may have contributed to this uncertainty in pelt income.
Table 2.2 Percentage of farms and national flock/herd of sheep, goats and cattle in the Traditional system kept in herd/flock size of 40 animals or less.

<table>
<thead>
<tr>
<th>Species</th>
<th>% Farms</th>
<th>% Animal population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goats</td>
<td>86.4</td>
<td>57.6</td>
</tr>
<tr>
<td>Sheep</td>
<td>90</td>
<td>44.3</td>
</tr>
<tr>
<td>Cattle</td>
<td>77.8</td>
<td>39.7</td>
</tr>
</tbody>
</table>

Source: CSO (2002)

Draught animals are donkeys, which are used for carrying loads in the farms, firewood, fetching water. Smallholder farms keep different species due to the different needs by farmers and the quest to reduce the risks in case of disaster like an out-break of disease.

Traditional farmers keep locally adapted breeds of goats, sheep, chicken and pigs. However pigs of local breed are confined to the Ramotswa, Tlokweng and Kgatleng district/area. The importance of local smallstock has recently been strengthened by the realization by a few goat farmers that exotic do not stand up to the harsh conditions. However, cattle farmers still believe that Tswana animals are less productive. The productivity of local cattle is perceived to be lower than that of introduced large framed beef breeds. This view is enforced by marketing strategies of exotic breeds by breeders from neighbouring countries where local farmers buy breeding stock. Promotion of livestock improvement through the use of exotic bulls by extension leading to upgrading of Tswana animals instead of producing F1 crosses for slaughter has resulted in destruction of local genetic material. Research has shown that Tswana cattle are productive (APRU 1980) and important. This is because these animals form a foundation stock for future breeding programmes. For example; ‘where decreased production has occurred through indiscriminate upgrading to exotic breed types, both Tuli and Tswana become valuable sire breeds for backcrossing’ (Light, Buck and Lethola 1982). A simulated study (Jeyaruban and Kapele 2003) using 300 breeding cows of improved Tswana, Brahman and Bonsmara showed that it is profitable raising Tswana cattle for beef production than Brahman.
Inputs in the Traditional Production system are relatively low except for big farmers within the system who are raising beef cattle. Subsistence farmers seldom buy feed or provide veterinary care or buy breeding stock. Mating occurs when animals from different herds mix during grazing or otherwise males for mating are selected within the herd. Big farmers however buy supplementary feeds (mineral-salt licks, drought feeds) especially during the dry period. They also buy drugs for minor ailments. The difference in levels of input by subsistence farmers and big farmers within the Traditional system means that big farmers can use exotic or crossbreds while subsistence farmers opt for local breeds, which are tolerant to diseases and can survive on limited feed supply. Government does vaccination for Quarter Evil, Anthrax, Brucellosis and Foot and Mouth Disease (FMD), which are of economic importance.

Risk factors in the Traditional system include drought, disease, and poor infrastructure development, lack of access to capital and unavailability of labour. The drought risk is less pronounced in goats than cattle because of their unique feeding habits. Goat feeds mainly on trees and shrubs and during drought is able to meet nutrient requirement for maintenance and even for limited production. The general phenomena observed in Botswana is that, during drought, cattle numbers decrease while those of goats increases. Recently, disease risk factor has taken toll on Animal genetic resources when more than 340 000 uncharacterised cattle in Ngamiland in 1995 were slaughtered to control lung disease (Contagious Bovine Pleuropneumonia) (Fanakiso; personal communication 2002). In 2002 another 12197 cattle including both imported and local cattle were killed in North East Botswana to control FMD (Letshwenyo; personal communication 2002.). Another 3 000 cattle were killed in beginning of 2003 at Matopi, in the north east of Botswana, to control FMD. In both occasions sheep and goats were not killed. A few pigs (131) were killed in Matsiloje to prevent the spread of the disease. Traditional chickens are under threat of new castle disease that occurs in most parts of Botswana.

Availability of capital for smallholder farmers is a constraint affecting the purchase of breeding stock. In the past, labour in the Traditional Production system was provided by the family but with rural-urban migration and loss of interest in farming by the youth, there is an increased need for paid labour. The following table for cattle, goats, sheep chicken and pigs illustrate the trends in livestock population.
### Table 2.3: Cattle, goats, sheep, chicken and pig population (‘000) from 1979 to 1998

<table>
<thead>
<tr>
<th>Year</th>
<th>Cattle</th>
<th>Goats</th>
<th>Sheep</th>
<th>Chicken</th>
<th>Pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>2840</td>
<td>616</td>
<td>152</td>
<td>740</td>
<td>6</td>
</tr>
<tr>
<td>1980</td>
<td>2911</td>
<td>638</td>
<td>149</td>
<td>883</td>
<td>6</td>
</tr>
<tr>
<td>1981</td>
<td>2967</td>
<td>621</td>
<td>140</td>
<td>1046</td>
<td>5</td>
</tr>
<tr>
<td>1982</td>
<td>2979</td>
<td>636</td>
<td>140</td>
<td>1146</td>
<td>5</td>
</tr>
<tr>
<td>1983</td>
<td>2818</td>
<td>783</td>
<td>165</td>
<td>961</td>
<td>5</td>
</tr>
<tr>
<td>1984</td>
<td>2685</td>
<td>889</td>
<td>167</td>
<td>714</td>
<td>7</td>
</tr>
<tr>
<td>1985</td>
<td>2459</td>
<td>1138</td>
<td>200</td>
<td>1020</td>
<td>9</td>
</tr>
<tr>
<td>1986</td>
<td>2332</td>
<td>1332</td>
<td>229</td>
<td>1179</td>
<td>11</td>
</tr>
<tr>
<td>1987</td>
<td>2264</td>
<td>1470</td>
<td>240</td>
<td>1283</td>
<td>11</td>
</tr>
<tr>
<td>1988</td>
<td>2408</td>
<td>1691</td>
<td>259</td>
<td>1810</td>
<td>13</td>
</tr>
<tr>
<td>1989</td>
<td>2543</td>
<td>1897</td>
<td>286</td>
<td>2013</td>
<td>15</td>
</tr>
<tr>
<td>1990</td>
<td>2696</td>
<td>2092</td>
<td>317</td>
<td>2126</td>
<td>16</td>
</tr>
<tr>
<td>1991</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1992</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1993</td>
<td>1821</td>
<td>1838</td>
<td>250</td>
<td>1077</td>
<td>4</td>
</tr>
<tr>
<td>1994</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1995</td>
<td>2530</td>
<td>2624</td>
<td>337</td>
<td>3157</td>
<td>1</td>
</tr>
<tr>
<td>1996</td>
<td>2249</td>
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<td>349</td>
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<td>1997</td>
<td>2212</td>
<td>2615</td>
<td>409</td>
<td>1191</td>
<td>2</td>
</tr>
<tr>
<td>1998</td>
<td>2345</td>
<td>2199</td>
<td>393</td>
<td>776</td>
<td>4</td>
</tr>
</tbody>
</table>


2.1.2 Commercial Production System

The breeds of sheep and goats raised on Commercial system are Tswana sheep, Dorper, Tswana goat, Boer goat or crosses, respectively. However the management of sheep and goat is extensive in ranches. Cattle under this system are beef cattle of exotic, or crossbreds with local Tswana. Dairy cattle are not as numerous as beef cattle. Common dairy breeds are Friesian, Jersey, Brown
Swiss and Guernsey and are kept under intensive or semi-intensive system. In some cases crosses between Tswana cattle and specialized dairy breeds are used or dual-purpose breeds such as Simmental. Beef cattle breeds under commercial are Charolais, Brahman, Simmental, South Devon, Santa Gertrudis, Sussex and others.

Table 2.4 Distribution of livestock by production system (%)

<table>
<thead>
<tr>
<th>Species</th>
<th>Traditional</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>93.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Sheep</td>
<td>96.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Goats</td>
<td>99.40</td>
<td>1.0</td>
</tr>
<tr>
<td>Horses</td>
<td>55.1</td>
<td>44.9</td>
</tr>
<tr>
<td>Donkeys</td>
<td>99.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Pigs</td>
<td>99.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Chickens</td>
<td>98.9</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Source: CSO (2002)

Animals used under Commercial system are cattle, sheep, goats, chicken, pigs, donkeys, horses and recently ostriches. The distribution of livestock species favour cattle, with small percent of the animals being sheep and goats, 7.6 and 14.2% respectively versus 78.2% of cattle (CSO 2002). Usually cattle, sheep and goat are kept together but sheep and goats numbers are always lower compared to cattle under this system.

The imported breeds dominate this production system (Table 2.6). This result from a belief that local breeds are of low productivity and the high inputs of veterinary and feeds are not justified by the low return to investment. This is especially true with beef, dairy cattle, sheep, goats, chicken and pigs where exotic animals are used. It is only in the ostriches sub-sector that indigenous strain is used.

Farms in this category are either privately owned, syndicates/groups, or are leased. For beef cattle, sheep and goat, the size of farms is large-scale commercial units. Small-scale specialized producers dominate the commercial dairy, pig ostrich and chicken farming. This system relies on additional inputs such as purchased feeds, veterinary care, and breeding stock. This high level of
inputs means that farmers use exotic stock or crosses, which are able to respond proportionally to the level of inputs to justify the costs of these inputs.

The risk factor of drought is less in this production system because of judicious feed management. And when the drought is severe farmers reduce stocking rate unlike in the Traditional system where farmers hang on to their animals until the animals die from starvation. Cattle in Commercial system are at the same risk as those in traditional system for economical disease such as Foot and Mouth Disease. However for other diseases like heart-water, cattle, sheep and goats are not at risk because of disease control practices. CSO (2002) reported lower death rates for cattle (4.5 vs 6.1%), goats (21.3 vs 30.6%) and sheep (17.3 vs 19.5%) in the commercial compared to the traditional sector for 1998 farm survey. However the causes of mortality are not mentioned.

Access to capital is not a limiting factor in this system since farmers can negotiate for loans from banks, advance feedlot schemes from Botswana Meat Commission and Citizen Entrepreneurial Development Agency (CEDA). Unavailability of labour constitutes a risk factor because of the reluctance of local people to work on farms preferring to move to urban areas. This has prompted the government to allow importation of farm workers from neighbouring countries. This risk factor is common to all livestock enterprises. The risk factor in the farm labour market may be exacerbated by HIV/AIDS. This is because the most active and able-bodied persons are the most affected.

2.2 Animal products and secondary products important to farmers or regions of the country.

The main products are meat, milk, egg, hides/skin, draught power, and storage of capital. The main reasons for producing these products in the Traditional system are both economic and social. However in the Commercial system the most important reason is financial gain. In most cases in the rural areas meat, storage of capital and social reasons (weddings, funerals, social status) are reasons for raising livestock. Local and imported breeds of cattle breeds are equally important for beef production. In the dairy industry imported breeds are important. Draught power from donkeys, hides and manure from sheep and goat are more important in rural areas. Sheep and goats are also used in the barter of good and services and both local and imported
breeds are equally important. Pelt from Karakul sheep is important in southern tip of the country where pelt is from traditional farms. Dairy goats are rarely used in Botswana. The local goat breed provides goat milk for home consumption only. Local and imported breeds of chickens are important for meat and egg production. Major providers of pork are exotic breeds and manure from pigs is not utilised. Donkeys of local stock provide draught power and meat in some rural areas of the country.

All livestock products except for beef, pelts, and hide/skin are produced for the local market. This trend has not changed much in the past 10 years but may change slightly with the export of meat and skin from ostrich and meat from donkey. International markets where Botswana sells its beef may be influenced by international market trends, tastes and preferences of foreign customers, disease and hygiene standards. Effects of coronary and heart disease on human health may lead to more people preferring white instead of red meat. These scenarios may cause a drop in market price for local beef. This would results in farmers holding on their animals and not market their animals. Market restrictions may occur due to sanitary, phyto-sanitary and quality measures.

2.3 Major trends or changes, which have occurred in the use and management of animals.

The past ten years saw the introduction of Financial Assistance Policy (FAP), which resulted in an increase in small-scale commercial chicken units. Small-scale units are found throughout the country and have played a major role in economic activities of rural areas. Increases in chicken production are due to government policy on rural development and the quest to diversify the economy from the beef and mineral led economy. However the chicken production using local chicken has not changed. The number of dairy units has increased from 88 in 1996 to 183 in 2001 but has not contributed significantly to milk production. For instance 3 162 852 litres of fresh milk was produced in 1996 (DAHP 1997) and 4 254 096 litres in 2001 (DAHP 2002) just an increase of 35%. In 2001 the deficit from national production was covered by importation of 49 518 485 litres (DAHP 2002). This high importation of milk and milk products is partly due to low productivity of animals and lack of expertise in the dairy industry.

A significant change in the livestock industry is the expansion of the poultry industry resulting in increase in eggs and poultry meat. Exotic chicken breeds are responsible for high productivity in
this sector. However the poultry industry still relies on fertilised eggs, day-old broilers as well as layers from South Africa and Zimbabwe. Ostrich farming has also made a contribution in diversifying products to be exported.

The major change that is affecting and will in future affect the production infrastructure and the organizational aspects of these structures in the Traditional Production system is the fencing component of National Policy for Agricultural Development. Grazing areas previously used on communal basis will be zoned into ranches and individuals or groups would use them on commercial basis. Fencing may avail farmers with opportunity to venture into wool production. Removal of Ram and Bull subsidies by government may change the current breeding trends of livestock in the Traditional system. On the other hand it might not, because animals still breed indiscriminately while on pasture regardless of the factor that one owns an exotic male or not. Ram and Bull subsidy scheme was introduced by government to supply farmers with exotic males for improving the national herd.

Major roads in the country have been tarred and this has improved transport of livestock to markets. This aspect of development was significant in the western part of the country, which is renowned for its contribution of beef cattle to BMC. Before this development, animals from the traditional and the commercial systems were trekked on hoof taking months before reaching the markets. The establishment of an Ostrich abattoir is bound to change the contribution of beef cattle to the market by increasing offtake since the abattoir also kills cattle. It is still early to say whether the ostrich abattoir will influence the marketing of cattle from the Traditional system and/or the Commercial system.

Factors affecting productivity in the Traditional system are uncontrolled mating, lack of management skills (feeding and veterinary care), no control of grazing resource, absentee managers, and lack of credit. The uncontrolled mating results in upgrading of the indigenous livestock but management in the Traditional system cannot sustain the upgraded breed. Consequently it produces below its potential and even below the indigenous breed. This is because the upgraded breed cannot tolerate harsh conditions of disease prevalence and limited nutrition found in the Traditional system environment. Ways of overcoming this problem will probably be provided by the fencing of communally grazed areas. Promotion of indigenous
breeds based on information generated by previous research will go a long way in reviving interest in indigenous breeds. Evaluation of meat from local animals for parameters such as flavors, tenderness, and chemical composition will provide information to base the marketing of local breeds. The formation of breed societies will also go a long way in promoting these breeds for example through branded-beef programmes. In the Commercial system the limiting factor is the reproduction management of the animals as shown by low average calving rate of 51% (CSO 2002). Calving rate at DAR ranches average at 70% (APRU 1992) This can be overcome by improving the understanding of reproduction and those factors that affect it, such as nutrition and disease, by the farmers.

Trends in the commercialisation of the livestock industry (table 2.5) and the preference for exotic breeds by beef farmers (Table 2.6) are shown below. Goats, sheep and donkey tend to increase in the traditional system.

Table 2.5 Changes in the distribution of production system during the last 20 years

<table>
<thead>
<tr>
<th>Species</th>
<th>Traditional</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Sheep</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Goats</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Horses</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Donkeys</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Pigs*</td>
<td>--</td>
<td>+</td>
</tr>
<tr>
<td>Chickens</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

Score: -- = strongly decreasing, - = decreasing, 0 = stable, + =increasing, ++ strongly increasing
Source: Central Statistics Office (1999), Seleka (1999), (Sydes*, personal communication)
Table 2.6 Percentage contributions of both indigenous and exotic bull breeds used in natural and AI in Botswana from 1987-1995

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Brahman*</td>
<td>59.0</td>
<td>59.1</td>
<td>57.8</td>
<td>56.0</td>
<td>58.6</td>
<td>60.9</td>
<td>61.9</td>
<td>43.1</td>
<td>52.1</td>
</tr>
<tr>
<td>Charolais*</td>
<td>24.7</td>
<td>16.9</td>
<td>15.7</td>
<td>8.3</td>
<td>11.9</td>
<td>15.8</td>
<td>4.1</td>
<td>9.4</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>1.9</td>
<td>1.7</td>
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<td>Simmental*</td>
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<td>10.6</td>
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<td>22.9</td>
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<td>14.2</td>
<td>23.3</td>
<td>12.2</td>
</tr>
<tr>
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<td>5.6</td>
<td>6.2</td>
<td>4.0</td>
<td>2.3</td>
<td>5.5</td>
<td>2.5</td>
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<tr>
<td>Gertrudis*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.3</td>
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</tr>
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<td>Sussex*</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>6.3</td>
<td>1.0</td>
</tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.3</td>
<td>10.7</td>
<td>6.8</td>
<td>8.6</td>
</tr>
<tr>
<td>Hereford*</td>
<td>-</td>
<td>-</td>
<td>1.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>South Devon*</td>
<td>0.7</td>
<td>1.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Africander</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.1</td>
<td>-</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Bonsmara</td>
<td>1.1</td>
<td>3.1</td>
<td>2.8</td>
<td>5.1</td>
<td>4.9</td>
<td>4.9</td>
<td>1.6</td>
<td>1.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Tswana</td>
<td>-</td>
<td>-</td>
<td>0.3</td>
<td>1.5</td>
<td>0.6</td>
<td>2.9</td>
<td>0.6</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Tuli</td>
<td>0.6</td>
<td>0.5</td>
<td>1.8</td>
<td>0.7</td>
<td>2.0</td>
<td>1.1</td>
<td>3.2</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Exotic %</td>
<td>98.2</td>
<td>96.4</td>
<td>95.2</td>
<td>92.7</td>
<td>92.6</td>
<td>91.0</td>
<td>94.7</td>
<td>96.8</td>
<td>96.1</td>
</tr>
</tbody>
</table>

* = Exotic bulls, Dashes (-) indicate unavailable data
Source: Nsoso and Morake (1999)
3. **THE STATE OF GENETIC DIVERSITY**

3.1 **The State of Knowledge of the Country’s Animal Genetic Resources**

Limited research has been done on few ruminant species and therefore limited information is available on these species. Most of the information available is mainly from the research done by the Ministry of Agriculture on sheep, goats and cattle. This work mainly involved the performance comparison of indigenous breeds with some exotic types. Information on wildlife is not readily available even though game farming is becoming popular. Unlike the Water buffalo, Botswana herds of Cape Buffalo do not contribute to food and agriculture.

3.1.1 **Information Systems**

Since 1967 the government has been conducting annual agricultural sample surveys of crops and livestock to meet its planning needs. The first livestock census was conducted in 1971 and in 1982 the first agricultural census was conducted (CSO 1995). In 1993 another agricultural census was conducted CSO (1995). However, from these surveys there is no information on the status of breeds within each animal species. These surveys only estimate livestock populations at species level covering cattle, sheep, goats, pigs, donkeys, horses and chickens. There is no information on the distribution of breeds across the country and the breed herd structure. However, there is some information on the herd structure of the national herd. The lack of information on the type of breeds limits decision-making on the use of breeds.

The agricultural statistics also provides information on livestock ownership by gender, birth and mortality rates, offtake rates, average flock/herd sizes and structure at district level and for the two production systems (Traditional and Commercial).

a) **The Domestic Animal Diversity Information System (DAD-IS)**

The Domestic Animal Diversity Information System (DAD-IS), a FAO database system, contains information derived from the cattle research information, which is provided by the Department of Agricultural Research. However, this information is old and has never been updated since 1995. Information from the National Agricultural Statistics is not contained in the DAD-IS. Further
more, some of the Botswana information in DAD-IS needs correction and to be made comprehensive, as most of the breed data fields are not filled with relevant information.

Limited capacity within the agencies tasked with data collection and analysis affects timely production of reports. There is some perception within some stakeholders that the CSO figures are an underestimate of the real situation in the field. Underestimation is often a result of lack of cooperation by some farmers who do not respond to mailed questionnaires (CSO, 2000).

b) Breed Monitoring Mechanism

There is a National Advisory Committee for the Management of Farm Animal Genetic Resources, which will looks into issues related to conserving breeds at the risk of extinction. There are no effective mechanisms to monitor the trends in breeds of each species. This is a result of the unavailability of data on specific breeds as there is generally limited record keeping within the livestock industry. Few commercial and institutional farms do record keeping. The lack of breed societies within the country also contributes to this state of affairs. However, a few commercial farmers are registered with the South African breed societies.

c) Livestock Identification and Traceability System

In 1999 Botswana started a national Livestock Identification and Traceability System (LITS) to trace origin of beef in order to meet the EU beef import requirement. This system has the potential to be used to collect useful information to monitor cattle breed information. This computerised system is at a fledgling stage, currently focusing on cattle and is not interfaced with the DAD-IS.

3.1.2 Characterization Studies

The Department of Agricultural Research conducted research on comparison of indigenous breeds of cattle and smallstock to some of the exotic breeds and their crossbreds. These evaluations were done on-station and they covered reproductive performance, growth, survival and overall productivity. Recently, limited research work has been done by the Botswana College of Agriculture on ruminants, chicken and pigs. Table 3.1 shows the number of the characterization studies on different species. The results of pure breed evaluations (APRU 1980) are that Tuli is superior to Tswana due to its high reproductive performance. Bonsmara, a
composite breed from South Africa out-performs Tswana while Brahman and Africander perform below Tswana. Crossbreeding studies found that crossbred cows of Simmental, Bonsmara, and Brahman had superior performance than pure Tswana or its Tuli crosses.

According to APRU (1980) productivity (i.e. combining traits of reproduction, mortality and growth) of the indigenous Tswana goat and Tswana sheep in the five-year studies showed that they were superior to the Boer goat and Dorper under Botswana conditions.

There are no breeding or characterization studies on wildlife that contribute to food and agriculture even the policy makers take cognisance of the fact that in future wildlife may contribute genetic material to domesticated animals.
### Table 3.1 Number of breeds that have been characterized

<table>
<thead>
<tr>
<th>Species</th>
<th>Baseline survey</th>
<th>Genetic distance</th>
<th>Breeds evaluation</th>
<th>Valuation</th>
<th>Performance testing/recording</th>
<th>Genetic evaluation</th>
<th>Molecular evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>4</td>
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<tr>
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<td>2</td>
<td>0</td>
<td>1</td>
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<td>0</td>
</tr>
<tr>
<td>Goats</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Camels</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Horses</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Donkeys</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pigs</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chicken</td>
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<tr>
<td>Turkey</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ducks</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Geese</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rabbits</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ostriches</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Comments:**
- Consider breed characterization during the last ten years.
- Baseline survey summary data describing the identification and observable characteristics, location, uses and general husbandry of the AnGR for each species used in the country for food and agricultural production.
- Genetic distances among breeds computed from molecular analyses.
- ‘Breeds and crosses evaluation’ refers to estimation of direct and maternal additive genetic, and heterosis effects.
- Valuation = description of the extent to which market values of AnGR predict their ‘real’ or ‘fair’ value, accounting for all goods and services they may provide to current and future generations of humankind. In the case of market failures, market prices will differ from the value that society attaches to AnGR.
- Performance recording is based on individual animal data for milk yield, growth, reproduction, etc.
- Genetic evaluation refers to estimation of breeding values.
- Molecular evaluation includes information of markers, DNA, blood type, protein alleles, etc.

### a) Cattle Studies

#### i) Beef Cattle

Relatively more research work was done on beef cattle breeds because of the importance of beef as a major export commodity for the country. Most of the research work was done or initiated in the seventies and eighties. An evaluation on the growth of beefalo was also carried out (Makobo
et. al., 1981). No molecular characterization studies have been done yet. The following studies were done and are available in the divisional reports:

(i) Pure breed Evaluations 1970-1980
(iii) Progeny testings of bulls 1971-1973
(iv) Tswana bull performance-testing 1971-1973
(v) Factors affecting cow reproductive performance 1972-1974
(vii) Effect of Zeranol on cattle liveweight gain 1974 – 1976
(ix) Composite breed development programme 1980 – continuing on station
(x) Selection of Tswana Cattle for beef production 1989 – continuing on station

ii) Dairy Cattle Studies

(i) Intensive Milking System (using Friesian cattle)
(ii) On-station partial milking (using Tswana and Simmental Crossbreds, Friesian crosses- 1980 –
(iii) On-farm partial milking system 1985 – 1990

b) Goats Studies

(i) Carcass evaluation of indigenous sheep and goats 1975-76
(ii) Breed Evaluations 1976 – 1987 i.e. Comparison of Tswana to Boer Goats and their Crossbreds (on station)
(iii) Effect of Season of Kidding on Goat Production (1985 – 1991) (on station)
(iv) Blood parameters of goats in Kgatleng Agricultural District 1986 – 1987
(v) Milk Production by Tswana goats in Tutume Agricultural District 1986
(vi) Breeding and Selection of the Indigenous Goats for Meat Production 1989 – continuing (on station)
(vii) Goat Milk Production 1995 – 1996 using Tswana, pure Saanen goats and their Crossbreds (on station study)
(viii) Reproduction of Tswana goats – 1998-2000
(ix) Physical Characterization of indigenous goats and sheep 2000 – 2001 (on farm study)
c) **Sheep studies**

(i) Sheep breed evaluations 1976 –1987 (Tswana to Dorper sheep and their crossbreds (on station)
(ii) Effect of season of lambing 1981 –1985 (on station)
(iii) Effect of dipping frequency on sheep production 1984-1985 (on station study on Tswana and Dorper Sheep)
(iv) Breeding and selection of the indigenous sheep for meat production 1989 – continuing (on station)
(v) Karakul 1999

d) **Studies on Avian Species**

**Chickens, Ostriches and others (Guinea Fowls, Turkeys, Geese, Ducks and Pigeons)**

Little research has been done on most of the avian species. However chickens and ostriches have become economically important. Department of Animal Health and Production and the Botswana College of Agriculture did a few management-related studies, mainly surveys. Research on mono-gastrics is an area of priority for diversification and requires capacity building of trained human resources to support the demands of this growing industry.

A study to evaluate and to select polymorphic microsatellite markers on Tswana chicken was done by van Marle-Koster and Nel (2000).

d) **Pigs**

Some management related surveys have been done on pigs.

e) **Donkeys and Horses**

Almost no studies have been done on equine species in Botswana.

f) **Camels**

No studies have been carried out but there is management information from the Department of Wildlife and National Parks.
g) **Wildlife**

Very little information is available on the use or management of wild life. However game farming is becoming popular. There are 55 game farms with a variety of animal’s species (Mathumo personal communication, 2003). A study on zebra population dynamics is in progress (DWNP 2003).

### 3.2 Assessment of Genetic Diversity

The following eight mammalian and about eight avian species are encountered in Botswana’s agricultural production system (Table 3.2). However, only five mammalian (cattle, sheep and goats, pigs, equines) and four avian species contribute significantly to food and agriculture production in Botswana.

<table>
<thead>
<tr>
<th>Mammalian species</th>
<th>Avian Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle (Beef &amp; Dairy)</td>
<td>Chickens</td>
</tr>
<tr>
<td>Goats</td>
<td>Ostriches</td>
</tr>
<tr>
<td>Sheep</td>
<td>Guinea Fowls</td>
</tr>
<tr>
<td>Pigs</td>
<td>Turkeys</td>
</tr>
<tr>
<td>Equines</td>
<td>Geese</td>
</tr>
<tr>
<td>Rabbits</td>
<td>Ducks</td>
</tr>
<tr>
<td>Camels</td>
<td>Pigeons</td>
</tr>
<tr>
<td>Dogs</td>
<td>Quails</td>
</tr>
</tbody>
</table>
Table 3.3 Breed Diversity (number of breeds in Botswana)

<table>
<thead>
<tr>
<th>Species</th>
<th>Local</th>
<th>Exotic</th>
<th>Local</th>
<th>Exotic</th>
<th>Local</th>
<th>Exotic</th>
<th>Local</th>
<th>Exotic</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sheep</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Goats</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Camels</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Horses</td>
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<td>7</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Donkeys</td>
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<td>NI</td>
<td>NI</td>
<td>1</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
</tr>
<tr>
<td>Pigs</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
</tr>
<tr>
<td>Chicken</td>
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<td>&gt;7</td>
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<td>0</td>
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<td>5</td>
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</tr>
<tr>
<td>Turkey</td>
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<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
</tr>
<tr>
<td>Ducks</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
</tr>
<tr>
<td>Geese</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
<td>NI</td>
</tr>
<tr>
<td>Rabbits</td>
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<td>4</td>
<td>NI</td>
<td>NI</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>NI</td>
</tr>
</tbody>
</table>

1. L = Locally adapted or native; 2. E = Exotic (recently introduced and continually imported)

Breeds at risk are those with total number of breeding females and males less than 1,000 and 20, respectively; or if the population size is less than 1,200 and is decreasing, NI = no information

3.2.1 Cattle Industry

a) Beef Cattle Breeding

Most parts of the country are suited to extensive beef production and the beef industry contributes the most output of the agricultural sector through the export of beef. Over ten breeds of beef cattle are used within the country. (Table 3.3) some of these include exotic breeds like the Brahman, Charolais, Bonsmar, Simmental, Sussex, Santa Gertrudis, South Devon, Gir, Africander and Hereford and the indigenous ones like the Tswana and the Tuli. There are other exotic breeds, which are very insignificant in terms of number and use like the Nguni, Dexter, etc. In Botswana, the Tuli and the Tswana comprise the locally adapted breeds while the remainder of the breeds are continually imported into the country as live animals or as semen.

The beef industry is experiencing a lot of change where the indigenous breeds, which used to dominate, are gradually declining in numbers. As a result of the rampant uncontrolled crossbreeding in most of the communal sector where most of the cattle are found, there is increasing numbers of crossbreds. The indigenous cattle comprised 50% of the national herd in
1992 (Senyatso and Masilo, 1996) but it is now estimated that the proportion stands at 40% (Masilo and Podisi, 2001).

The Brahman breed is widely used across the country (Nsoso and Morake 1999) and its strong influence can be seen in most of the crossbreds found in the country. This was partly due to government policies like the Bull Subsidy Scheme under which a good number of farmers acquired bulls of exotic blood or their crossbreds for breeding purposes. Most of the pure exotic breeds are found in commercial ranches while the Tswana and a majority of crossbreds are found in the traditional sector. None of the commercial farms keep pure Tswana cattle. The pure Tuli cattle are also found in a few government research farms (Masilo and Podisi, 2001).

The use of the Brahman as a sire breed is widespread and the Charolais is also gaining popularity. The wide use of crossbreeding is the result of government policy to improve the national herd through crossbreeding since research results showed that crossbreds grow faster than pure Tswana (APRU 1980). Though research recommended raising F1 crossbreds for slaughter, farmers went on to upgrade their Tswana herds to exotic breeds.

Another reason for the uncontrolled breeding is due to the difficulty in controlling breeding in communal areas because of absence of infrastructure such as fencing. Most of the farmers tend to upgrade their animals towards their exotic parental breeds because farmers also target producing heavier carcasses, which fetch better prices at the Botswana Meat Commission, the major beef cattle market outlet. Breeding for heavy carcasses with continental breeds in a drought prone country like Botswana requires support in the form of feed subsidies during drought years. Botswana government is reviewing its policy on agriculture subsides.

b) Artificial Insemination

The Ministry of Agriculture is encouraging the use of artificial insemination (AI) to improve the national herd. The government has built a number of AI camps across the country. The most popular imported semen breeds used in AI in descending order include; Brahman, Charolais, Simmental Holstein Friesian, Jersey, Brown Swiss. South Africa remains the major source of exotic live animals. (Kapele, personal communication).
Data from Ramatlabama Bull Stud and Artificial Insemination Laboratory, for the period between 1987 and 1995 show that, the bull breeds used included indigenous breeds (from the region): Tswana, Tuli, Bonsmara, Africander and exotic breeds: Brahman, Simmental, Hereford, South Devon, Santa Gertrudis, Friesian, Charolais, Pinzgauer, Sussex, Gilbviech and Jersey (Nsoso and Morake, 1999). From this data, the use of exotic bull breeds in Botswana was significantly higher than that of indigenous bull breeds in natural service (94.9 vs 5.1% per year) and as semen (94.1 vs 5.9% per year).

c) Dairy Cattle

Three major breeds of dairy cattle (Friesian, Brown Swiss, Jersey) are mainly used in dairy production. Simmental, Guernsey and different crossbreds comprise the remaining proportion of dairy cattle (Tahal, 2000). The Simmental is used mainly in the Kweneng, Ghanzi and Tsabong districts while the Guernsey is mainly found in the Francistown Region. The National Dairy herd of 4217 (DAHP, 2002), show that there is inadequate numbers of dairy cattle to meet the demand for fresh milk, which is being imported with other milk by-products from neighbouring countries. The Friesian is the major breed used in large-scale commercial operations but the smallholders predominantly use Brown Swiss and different crossbreds. Most of the milk produced in Botswana comes from smallholders (79.8%, Tahal, 2000) who keep an average number of 19.3 cattle per herd. This sector is faced by low productivity; milk production rates of 2 381 litres per cow per year, high stock mortality rates (26.3%) at young ages.

In the past the traditional partial milking of suckling indigenous (Tswana) cows has been a traditional system for getting milk to improve and balance human nutrition especially in the rural areas. The increase of beef prices by the Botswana Meat Commission in order to advance the exportation of beef has since suppressed the interest of most farmers in milking their beef cows. However, where the location and market opportunities occur, especially around major villages and towns, some farmers still milk their Tswana cows and sell the milk fresh or as sour milk (Tahal, 2000).

There have been proposals to select and use Tswana cows in dairy production as crossbreds or as a selected dairy line. Smallholder farmers who could not afford the management requirements of pure exotic dairy breeds like the Friesian have used the Tswana dams for crossbreeding or as a
herd multiplication strategy. In 1985 A Small Scale Dairy Research Pilot Project in the peri-urban areas of Gaborone evaluated the use of Simmental–Tswana crossbreds and Tswana cows for milk production by smallholders. It was found that Simmental-Tswana crosses produce two times (3.1 vs 1.6 l/d) (APRU 1987) more milk than Tswana cows but the economic evaluation showed that the returns to investment due to high management inputs were negative. A government research station is producing crossbreds from Sahiwal semen for evaluation. This breed has not been used much in the country probably due to the difficulties in procurement of the animals of this breed and due to lack of information.

3.2.2 Sheep and Goats

To address the mounting concern about the disappearance of indigenous breeds due to rampant crossbreeding a local sheep and goat farmers association initiated a project on the Conservation of Tswana sheep and goats with funding from the Global Environment Facility – Small Grants Programme. The government policy is supportive of the conservation of agricultural resources. Due to the recognized potential of the Tswana goats and sheep in terms of adaptability under the local production environment, the Department of Agricultural Research initiated an on-station selection program to improve Tswana sheep and goats (APRU 1992).

The Tswana and the Boer goat are the major goats breeds used within Botswana. Other goat breeds of less significance in terms of numbers include the Saanen, Savanna Kalahari Red and Toggenburg. Although the Tswana goat is a major goat breed used, a significant number of farmers are increasingly using the Boer goats for crossbreeding and keeping it as a pure breed. The problem posed by the use of the Boer goat in most parts of the country is its susceptibility to heart water, especially in the eastern part of the country. Under local conditions, the indigenous Tswana goat outperforms Boer goat in terms of productivity index (APRU 1980).

The Tswana, Dorper, Karakul and Damara are the major sheep breeds used within the country. In terms of numbers the Tswana is the main breed and is often crossbred with the Dorper for meat production. The Tswana is superior to the Dorper in terms of productivity under local conditions mainly due to survival (APRU 1980). The Karakul is mainly kept in southwestern part of the country mainly in the Kgalagadi District and is used for pelt production. At times farmers crossbreed Karakul with some meat type sheep when the prices of pelt are not attractive. The
Damara is a meat type sheep breed and is mainly found in the northwestern part of the country predominantly among the Herero people. The Black-Headed Persian and the Ele de France are other sheep breeds, which are found in the country but are very few in numbers. No wool is produced within the country except for some carpet wool from the Karakul industry.

3.2.3 Pigs

Botswana has a very low number (4000; CSO, 2002) of pigs probably due to the low consumption of pork around the country. Large White, Landrace and Duroc are the continuously introduced commercial breeds used within the country. The number of indigenous (Tswana) pigs is not known but they are very few and are declining in number due to lack of market. The government has taken measures to conserve Tswana pigs.

There are some wild pigs (warthogs), which are managed and conserved as part of the country’s wildlife, and they do not contribute to food and agriculture but to wildlife tourism.

3.2.4 Equines (Horses and Donkeys)

There is generally lack of information on the breeds of equines within the country. The breeds of donkeys are poorly understood. There is generally a perception that there is a locally adapted breed of donkeys (Tswana) and that of Horses (Tswana).

There are a number of exotic horse breeds within the country, which includes Thoroughbreds, Arabian, Quarter horse, Boerperd, Hanoverian, Welsh Pony, Nooitgedachter and different grades of crosses.

Donkeys are widely distributed across the country than horses. To produce mules farmers mate donkeys and horses for the purpose of draught power. The Arable Land Development Programme (ALDEP) popularized the use of donkeys when they were provided as part of the aid-package for draught power purposes. The donkey population has grown steadily over the years and some have even gone feral. For instance donkeys were reported to be 158 000 in 1990 but increased to 404 000 in 1999 (CSO 2002).

The Zebras (wild relative of equines) contribute to wildlife tourism but not to food and agriculture.
3.2.5 Camels

Botswana has one breed of dromedary camels, which were introduced from South West Africa (Namibia) in 1921 during the colonial era. They have existed then as an isolated population with no introductions from outside and are now regarded as a locally adapted population. Recently most of these camels have been distributed to communities for use in tourism purposes their potential for agricultural use has not been exploited. This herd is made up of less than 100 breeding females and is listed as critical in the World Watch List for Domestic Animal Diversity (Food and Agricultural Organisation (FAO), 2000).

3.2.6 Rabbits

The population of rabbits within the country is not known but at least five breeds of rabbits are available in the country and most of them are kept under youth projects in schools for meat and as pets. The breeds used include New Zealand White, New Zealand Black, Chinchilla, California White and California gold. New Zealand White and California White are the most common.

3.2.7 Chickens

Chickens particularly, the indigenous are one of the most widely and evenly distributed livestock species in the country. The population of indigenous chickens was estimated at 3.5 million (Moreki, 1997). Their contribution to human nutrition (meat and eggs) and economic well being of the rural communities is vital. The existence of different breeds or strains within the indigenous chickens has not been studied. However the existence of naked neck, rumple, feathered crest, feathered legs and fizzle-feathered genotypes are present within the population (Masilo and Podisi 2001). Their potential use in providing organic white meat remains underutilized due to lack of inputs and information by farmers most of whom are women. Some limited crossbreeding is occurring between the indigenous types and the exotic breeds especially in major villages and in the peri-urban areas where access to culls of commercial breeds from poultry projects is possible. There is a government program to promote the sustainable utilization of indigenous poultry resources. There are no breed improvement programmes for indigenous chickens in the country. The amount of eggs and meat produced by Botswana’s indigenous chickens is not known. Promotion of research on improved management of indigenous breeds of
poultry is a strategy outlined under the livestock sub-sector of the Ministry of Agriculture, which is in line with the conservation of indigenous species.

About five hybrids of chickens can be classified as continuously imported in the poultry industry. The three commercial broiler hybrids used are Ross, Cobb 500 and Indian River. Hyline Silver Brown and Hyline Brown are the ones used for commercial egg production. Fifty-six percent of commercial smallholder chicken farmers around Southern Region of Botswana use Ross hybrid and 40% of the smallholders keep less than 1000 birds per farm (Aganga et al., 2000).

The chicken industry has been growing fast through the importation of day old chicks and point of lay pullets and has managed to meet most of the local demand for eggs and broiler meat. In 2001 about 15 143 244 hatching eggs were imported from South Africa and Zimbabwe. National Chicks Botswana is the only commercial hatchery in Botswana. It hatched approximately 12.6 million day old broiler chicks in 2001, (DAHP, 2001). Over 25 million broiler chickens were slaughtered in 2001 while about 20 million chickens were slaughtered in 1999. The layer population also grew from 240 000 in 1999 to over 300 000 in 2000 representing an increase of 25%. Sharp increases in per capita consumption of both chicken meat (28%) and table eggs (48%) have been reported and the success of this industry has been attributed to FAP, which gave financial grants to entrepreneurs (DAHP, 2001) and due to the affluence of the buying consumers.

The small scale poultry enterprises constitute about 80% of all commercial enterprises in Botswana and produce 29% of all eggs and 64% of chicken meat from the commercial poultry sector, while 71% of eggs and 36% of chicken meat come from medium and large scale enterprises. Most of the poultry feed (57%) used in the country is imported and three feed mills produce 43% of local supply.

3.2.8 Ostriches and Guinea Fowls

Ostrich farming is at a fledgling stage and is expected to grow especially with the newly constructed abattoir, which is targeting the export market. There were a total number of 8 registered farms keeping a total number of about 3 164 birds in the year 2000 (Podisi, 2001). In 2002 there were about 16 ostrich farmers in Botswana. The initial birds reared in Botswana were
captured from the wild and their later progeny are sold to new ostrich farmers. Policy restrictions forbid the sale of the captured birds therefore it is easier to buy starting stock from established farms, which are allowed to sell from subsequent generations of the captured stock. Government also restricts the importation of other strains in order not to contaminate wild ostrich strains.

There is an increasing interest in guinea fowl farming but there are no statistics on the populations of birds under domestication. Up to the last quarter of 2002 about 217 licences (Sisimogang, personal communication) for guinea fowl farming had been issued but the numbers of birds reared is not available. Domesticated guinea fowls sourced from South Africa are mainly used, when the rearing of wild ones is unsuccessful. Some insignificant importation of guinea fowl meat (5000 kg) was reported in 2001 (DAHP, 2001).

3.2.9 Turkeys

Demand for turkey meat comes next after chicken meat. Imports of turkey meat were in the region of 55 tonnes in 2001 (DAHP 2001). Few households own turkeys, but there is no data on the numbers and distribution of ownership of these species across the country. The common breed encountered is the American Turkey.

3.2.10 Ducks and Geese

There is limited understanding of breeds of ducks and geese due to their insignificant contribution towards food and agriculture. The Muscovy duck is the common breed in the country. The demand for duck meat is reported to be too low with importation of only 4 tonnes/year (DAHP 2001), to justify its local production. The breeds are not known.

The majority of the farmers who own geese keep them as pets rather than for meat and eggs.

3.2.11 Quails and Pigeons

Quails and pigeons are some of the avian species found in Botswana, however, their contribution to food and agriculture is negligible. Pigeons are more or less used as pets. The breeds of these species are also poorly understood.
4. THE STATE OF UTILISATION OF FARM ANIMAL GENETIC RESOURCES

Farm animal genetic resources supply food, hides/skins and draught power. There is perception that indigenous beef cattle, sheep, goats, pigs and chickens are not as productive as expected thus the need for their genetic development. Exotic animals are stressed by harsh local conditions however exotic cattle and pigs do well under good management.

4.1 The state of the use of animal genetic resources.

4.1.1 Policy and legal instruments.

The general policy on the development of agriculture promotes the commercialisation of the sector (National Policy for Agricultural Development, 1991). There is no specific legislation that prevents the use of animal breeds, except for ostriches. In addition there is no legislation that restricts the use of species in ecological areas or production systems. Therefore the commercialisation of the sector has seen a shift towards exotic breeds for cattle, sheep, goats, pigs and chickens.

The country has no legislation or policy to protect the use indigenous knowledge and practices relevant to the use of animal genetic resources. There has been no documentation of indigenous knowledge and practices in management of animal genetic resources. It is therefore recommended that this information gap be filled so that appropriate action is taken to protect the knowledge and also use it to develop management systems for animal genetic resources.

The need to establish institutions to regulate the use and collection of semen and embryos, register and control the operations of inseminators, monitor the operations of performance recording scheme, and monitor the operations of the studbook was established in the review of livestock related legislation and acts (Conference held by the DAHP 2000 at National Veterinary Laboratory). At this conference there was a proposal to develop legislation that will establish an institution called the Livestock Services Centre. There was also a proposal to review the current Registration of Livestock Act (cap 36:04) to allow farmers to register breed societies in Botswana.

Botswana has ratified the Convention on Biological Diversity, which requires the signatories to come up with legislation that promotes benefit sharing with farmers and communities on
commercialisation of biological resources. Although the convention was signed in 1995 the country is still in the process of developing a country strategy and action plan. The strategy and action plan shall come up with proposals on the legislation that must be put in place to regulate benefit sharing on the use of animal genetic resources for commercial purposes. No attempts have been made to patent live animals.

4.1.2 State of use by species.

The government of Botswana has invested a lot of resources to breeding of livestock even though there is no breeding policy. In cattle, the government initiated a Bull Subsidy Scheme through which farmers were assisted to purchase bulls to improve their herds. Unfortunately the effectiveness of this scheme has never been evaluated, however it is blamed for the uncontrolled crossbreeding that is found in the communal areas. The scheme supplied bulls that were not performance tested hence their genetic superiority were never established. The scheme has since been phased off except for Dairy bulls from government Research herds. The government is in the process of establishing a dairy multiplier herd through which it will supply dairy producers with good quality cows. The AI scheme also helps cattle farmers to import semen from all over the world. Farmers are not charged the market price for the semen and traditional farmers can take their cattle to an AI camp for breeding at a subsidized cost. Once again performance of progeny from this AI schemes is not monitored. Currently the Department of Agricultural Research is running a pilot beef-recording scheme. The scheme is meant to assist farmers to select top quality breeding stock and may help the establishment of an open nucleus selection programme for Tswana cattle.

Government produces breeding rams for exotic Dorper Boer sheep and goats at different farms such as Lobu, Mantshwabisi and Natale. The rams are sold through auction sales to producers. Unfortunately this programme gives the farmers the impression that these are the breeds that must be used to improve the genetic quality of sheep and goats. Lately there have been a few Saanen goat bucks sold in the auctions from demonstration farms.

The government also breeds and supplies weaners and female breeding stock to pig farmers. The common breeds are crosses of Large White and Landrace or Duroc, with preference for Landrace x Large White.
The government has no specific breeding initiatives for other species such as chickens, ostriches, horses and donkeys. Given that donkey meat may become an important product, there is need to develop a breeding strategy to improve donkey meat quality.

Botswana only exports beef, pelts and ostrich meat and these are the only products that are influenced by exports markets. The European Union market favour large framed beef cattle and therefore cold dressed weight has become one major factor in determining the price of beef cattle at the Botswana Meat Commission (the only export abattoir). However both local and exotic beef cattle breeds are used for both markets but because of this bias there is a shift towards rearing large breeds such as Simmental and Charolais for cross breeding.

The ostrich industry is still at the fledgling stage and it will use locally adapted ostriches for the export market.

There is no discernible trend in the domestic market that indicates different demands for various livestock products or parts. The demand for meat is more in towns than in rural areas because of higher population concentration and better incomes. There is a school of thought that suggests that the demand for chicken meat has grown relatively faster than that of red meat but there is no empirical evidence for these assumptions. Poultry Section of Ministry of Agriculture reports that the per capita consumption has increased from 16kg to 20kg of meat per person per year (DAPH 2001). However, these figures do not include meat contributed by indigenous chickens since there is no data on their usage. There is also an increase in the demand for pork in urban areas due to high concentration of expatriates. In the rural areas, some people do not consume pig meat due to religious reasons resulting in the decline of importance and utilization of Tswana pigs in the domestic market.

In the Botswana context there is only one species that is used to exploit a particular ecosystem (desert). The Karakul sheep are confined to the Southern tip of Botswana the Kgalagadi desert. These sheep are adapted to that area and are used to produce pelts for export to the European Markets for further processing into leather products.

Cultural, religious and social factors are important in cattle, sheep, goats and pigs rearing. Cattle, sheep and goats are used to pay the bride prize, used in traditional healing ceremonies, and are
slaughtered for meat at funerals and weddings. In some cases cattle are kept for prestige. The BaHerero community at Charles Hill in Ghanzi have reported to Podisi and Masilo (2001a) that they are particular about certain colour patterns in cattle and therefore will select a breed on the basis of its dominant colour. There is need to research and document this type of information. Horses are kept for recreation such as horse racing and a breed such as, Thoroughbred is preferred for racing.

The overall contribution of locally adapted cattle (Tswana) to food and agriculture is declining because they are gradually being upgraded to other breeds. There are indications that Tswana cattle are declining in proportion to the national herd. Masilo and Podisi (2001) noted that there are 40% purebred Tswana cattle. The recently introduced breeds are Charolais and Santa Gertrudis, which are increasing their contribution particularly in commercial operations. The continuously introduced breed is the Brahman that has been used mainly for cross breeding in both the traditional and commercial farms.

Concerning sheep and goats, the locally adapted Tswana continue to be the major breeds in the traditional farms and their contribution to food and agriculture has stayed the same. The commercial sheep farms have introduced Persian and Dorper that are also increasing their contribution to food. The commercial goat farms are using the Boer goat, which is also used for cross breeding by traditional farmers. Its contribution to food and agriculture is increasing steadily.

The contribution of Tswana chickens to food and agriculture has declined in urban areas but has stayed high in rural areas. Commercial chicken farms use the hybrid chickens and their contribution to food and agriculture at national level has increased significantly.

The importance of Tswana pigs for both food and agriculture has declined over years at national level and amongst traditional farmers. The commercial farms keep breeds such as Duroc, Landrace and Large White and their contribution to food and agriculture has increased steadily.

Ostrich farming is being promoted but the ostrich abattoir is operating below capacity, an indication that its contribution to agriculture is insignificant. Ostrich farmers are using locally adapted breeds only because farmers are restricted from importing other strains. Other livestock
species (horses donkeys, ducks, geese rabbits and camels) play an insignificant role in food and agriculture.

4.1.3 Breeding of Indigenous animals

Farmers in the traditional sector have no breeding strategy and the communal set up also hamper any efforts by farmers to adopt any breeding strategies. Locally adapted cattle such as Tswana are hardly kept as pure bred because one never find pure Tswana bulls except in government ranches. Commercial farmers do not breed pure Tswana cattle because they regard them as an inferior breed. The lack of studbook has made even the straight breeding programme difficult to implement because in most cases pedigree information of bulls supplied by the local market is not available.

Tswana goats are bred pure in the communal areas but the breeding programme is not structured and in some cases Boer goats are used for cross breeding. The adapted Tswana are also crossed with Dorper or Persian. Some commercial farmers breed the continuously introduced Dorper pure.

As for pigs, Government operates a structured cross breeding of pigs through its multiplier flock and supplies the farmers with weaners and breeding stock. The Tswana pigs are not part of the breeding scheme. There is no breeding work for commercial and traditional Tswana chicken in Botswana. The chicken hybrids are imported as day old chicks from South Africa or as fertilized eggs for incubation. There are no breeding strategies or patterns for other species and may be one will be developed for ostriches in the near future.

The only species evaluated for breeding potential are cattle, sheep and goats. With cattle, it was noted that the best performing pure breed is the Tuli due to its high reproductive performance and low mortality (indicating adaptability) followed by the Bonsmara, Tswana, Brahman and Africander in that order. The Brahman and Simmental were found to be good for crossbreeding with Tswana cattle. A synthetic beef breed was produced that has good growth and reproductive performance. The second phase cross breeding trials showed that the Charolais crosses with Tswana grow fast and have good feed conversion efficiency. Breed comparison in sheep and goats showed that the Tswana sheep and goats are superior to Dorper sheep and Boer goats.
respectively, mainly due to low mortality, an indication that the local breeds are more tolerant to diseases. Crossbreeds were in both cases intermediate in terms of growth and disease tolerance.

The only sustainability is in cattle, sheep and goats where government has established conservation herds and flocks of local breeds in government farms. The breeds are bred pure and also selected for better growth, reproduction and survival rates. However this is a closed nucleus system and therefore there is need to encourage farmers to keep Tswana cattle. As indicated earlier there are some farmers that are trying to conserve Tswana sheep and goats but their flocks are not linked to the government selection flocks.

Few commercial farms produced crosses between \textit{bos taurus} and \textit{bos indicus} breeds to create cattle that have good growth rates but are hardy enough to survive under extensive management. One such example is a cross between Brahman and Charolais. The Department of Agricultural Research has crossed Tswana cows with Charolais, South Devon, Sussex, and Santa Gertrudis bulls. Further more these crosses were bred to the Brahman to produce terminal 3 way crosses. However, the three way crosses were not any better than the first crosses.

On other species, cross breeding is used in pigs to improve reproductive rate and growth. The common crosses are between Large White, Landrace and Duroc. There is no breeding programme for poultry, horses, donkeys and ostriches. In general farmers breed in an unstructured manner and there are no well defined cross breeding strategies except in a few cases.

4.1.4 State of capacity to use Animal Genetic Resources.

There is a pilot beef performance-recording scheme with only 13 farmers participating and as such genetic evaluation has not yet started. However, DAHP uses semen from genetically evaluated foreign bulls using expected progeny difference (EPDs) for various traits. This means that farmers in Botswana are unable to participate in the production of bulls that can be used at AI centres because the bulls are not genetically evaluated. In addition there are no breed societies to facilitate recording of pedigree information (i.e. pedigree verification system). Embryo transfer and molecular tools (marker assisted selection) are not yet used in Botswana because of lack of capacity in terms of facilities and personnel to implement new breeding technologies. AI is only used in cattle and all other species in Botswana use natural breeding. There are no performance
recording schemes for these species including dairy cattle. Lack of capacity in terms of personnel and facilities in the poultry industry could be the reason for the continued importation of fertilized eggs, day old chicks and point of lay pullets.

Farmers have access to exotic breeds (pigs, sheep, goats, beef cattle and dairy cows) through agricultural agencies of the Ministry of Agriculture. Individual farmers also sell breeding stock to other farmers but this is hampered by the absence of breed societies that can confirm the pedigree of the animal and the performance recording schemes that can do the genetic evaluation of the animal. A number of private companies (both local or from aboard) provide farmers with animal genetic resources in the form of bulls or semen for cattle, eggs for hatching, day old chicks and live ostriches. The farmers are not organized into cooperatives, breed societies or companies that can market breeding stock because farmer organizations in Botswana are not very strong.

The Department of Agricultural Research (DAR) carries out animal breeding research and it concentrates in beef cattle, sheep and goats. Other species are not covered due to shortage of manpower. The research focused on breed comparisons, selection within breeds but areas such as molecular tools have not been utilised including the use of embryo transfer. Agricultural extension services in the DAHP advise farmers on breeds that are suitable for Botswana and they cover dairy cattle, beef cattle, goats, sheep, pigs, and chickens. The Botswana College of Agriculture (BCA) trains students on animal breeding as a subject but does not offer specialized postgraduate training on animal genetics, or molecular biology. This highlights capacity limitations within the country that needs to be addressed. Aspects of animal health as a subject are only confined to Diploma level. There is a shortage of veterinary graduates but constant outbreak of diseases (lung disease and FMD) erodes animal genetic resources and this is compounded by government policy of managing the diseases, which entails killing. Emphasizes in animal nutrition, feeding management and drought mitigating strategies needs to be made since this country is prone to drought, which also play a major role in eroding animal genetic resources. Sustainability of indigenous breeds including those of pigs and chickens needs special attention in the BCA’s curriculum in order to help students appreciate the economic and scientific value of indigenous breeds.
4.1.5 Trends and Future use of Animal Genetic Resources.

Commercialisation of agriculture has resulted in the importation of breeds of livestock that are considered to be more productive. However, it is not easy to record the changes because Agricultural Statistics do not record breeds. As indicated earlier there are some beef farmers that import bulls or semen of various beef breeds such as Charolais, Simmental, Brahman, Limosin, Sussex, South Devon and Santa Gertrudis. This has reduced the use of adapted breeds such as Tswana and Tuli cattle. The sheep and goat farmers are also using Dorper sheep and Boer goats that are produced in government ranches and sold to producers. There are no apparent indications that the breed composition has changed even though Dorper sheep and Boer goats are promoted and are increasingly purchased by farmers. The increase in the number of dairy farms indicates that more dairy cattle have been imported in the country and the breeds are largely Friesian, Jersey and Brown Swiss. Dairy cattle however still make a very small proportion of the cattle population which is estimated at 4217 head (DAHP 2002) out of 2,3 million cattle. The growth of the poultry industry has seen a great shift of chicken breeds because now the commercial hybrids make about 78% of the chicken population. However it is worth noting that the commercial poultry industry grew substantially over the past few years and it can then be concluded that commercial chicken hybrids have increased their contribution to food and agriculture. The same trend is found in pigs. The only relatively new species introduced is ostrich. Ostrich farming is relatively new but the birds that are used are the indigenous ostriches that are captured from the wild. In terms of breeds within species it is not easy to estimate the relative importance of each breed to the overall food and agriculture sector.

There are indications that international policy will affect the future use of animal genetic resources but it must be noted that the introduction of patents in living organisms as is the case with plants may extend to livestock and restrict access to breeding stock.

4.2 The state of development of Animal Genetic Resources.

The information that is required in this section is the same as the one provided in section 4.1 but there are a few subtopics that will be covered in more detail. There are isolated efforts to develop the quality of animal genetic resources as reported earlier. The Department of Agricultural Research has started a selection programme for Tswana cattle, sheep and goats using a closed
nucleus approach. The success of this selection programme will be limited by lack of legislation and institutions that regulate the operations of a performance recording scheme and registration of breed societies.

4.2.1 Policy and legal instruments.

The legal instrument that regulates the performance-recording scheme and the operations of breed societies is absent and the Registration of Livestock Act (cap 36:04) in use is outdated. The act requires farmers in Botswana to register breed societies in South Africa and as a result the indigenous breeds such as Tswana cattle will not register because they do not have it in South Africa.

4.2.2 State of genetic development.

Botswana has no defined genetic development strategies that use modern techniques such as embryo transfer and molecular biology. Limited breeding programmes were developed for cattle, sheep and goats for reproductive rates, growth rates and mortality. Only the Department of Agricultural Research has used both phenotypic and genetic traits to select cattle, sheep and goats. A few beef farmers have participated in the South African Beef recording scheme. The Department of Animal Health and Production (DAHP) demonstration farms only uses phenotypic traits to select sheep, goats and pigs. The performance of the progeny is hardly recorded. The Animal Breeding Section of DAHP use genetic traits to select bulls for AI whose genetic evaluations were done in other countries but there is a need to verify performance of their progeny from AI centers in Botswana. The absence of a fully operational performance recording scheme and limited research in biotechnology makes it very difficult for the country to adopt modern genetic improvement methods for any livestock species. The limited studies that were done on carcass quality in sheep and goats were not linked to the breeding programme.

4.2.3 State of capacity for the development of animal genetic resources.

There is limited capacity at national level to carry out a comprehensive straight breeding programmes for all livestock species although the situation is better for beef cattle, sheep and goats and to a limited extent pigs. Apart from the absence of breed societies, there are limitations
in both human resources and facilities. In general there are only a few animal breeders with postgraduate qualifications, there are no laboratories for biotechnology to support research in molecular biology. There are also a few researchers with postgraduate qualifications in biotechnology. There are a few beef farmers that are involved in the straight breeding programme to produce bulls for the market. Some do it for sheep and goats but the quality of this breeding stock cannot be verified. Lack of record keeping because of high level of illiteracy among farmers and lack of management skills is a constraint in development and monitoring of animal genetic resources.

4.2.4 Trends and future development.

Government carries a pilot performance-recording scheme on beef cattle. A committee that includes farmers will be set up to monitor the scheme. Only 13 farmers are participating. Farmers are not paying anything but in future they will be required to pay for some of the services. It is expected that advancements in biotechnology such as gene marking, genetic modification and embryo sexing will hasten genetic development and development of new breeds in all species. As indicated under 4.1 there are threats of intellectual property rights that may hinder access to certain breeds and animal welfare conditions may prohibit intensive production systems such as found in poultry and pig production.

4.3 Opportunities and obstacles in the use and development of Animal genetic resources

As countries move into new areas of technology and increased productivity indigenous livestock, which are perceived as unproductive under commercial systems are faced with challenges. However, some the species and breeds of animals that do not have an economic value now may in future have both economic and scientific value. Therefore it is important to come up with strategies to take advantages of opportunities that are availed by these animals and overcome obstacles and threats that may undermine their future contribution to food and agriculture.

4.3.1 Opportunities

There are opportunities for the improved use of locally adapted breeds of cattle. Research findings showed that Tuli and Tswana breeds are highly productive and have good reproductive
performance. They are also good for cross breeding with larger breeds such as Charolais Simmental and Brahman. As the demand for organic beef increases these breeds stand a good chance of being the cattle of choice because they are hardy. The same applies to Tswana goats and sheep including the Damara. The adapted ostriches will be used more as the ostrich industry grows. There are opportunities that donkey meat can be exported to Europe and therefore the donkeys may be used more for meat production as opposed to the present where they are mainly used as draught animals. Plans are under way to import Sahiwal semen but Boran cattle are difficult to import due to disease control restrictions. The use of local pig for lard production is another possibility.

Most of the locally adapted breeds have not been selected to improve their genetic quality. There is great potential for the genetic development of indigenous cattle, goats, sheep, ostriches, chickens because they have not been previously subjected to intensive selection. Tswana cattle, sheep and goats are being conserved and improved at government ranches for extensive farming system. There are no strategies for developing any species for an intensive system. Plans are under way to develop facilities where indigenous chickens and ostriches will be selected for production traits. Locally adapted ostriches will add a new animal products, ostrich meat and skin to the market and this is some form of diversification.

The increased demand for animal products, and the demand for organic animal products will influence the use of animal genetic resources in Botswana. There will be a shift to intensive production in the urban and peri-urban agriculture. On extensive agriculture the shift will be to large-scale operations to take advantage of economies of scale. In all cases there will be need to improve productivity and as such performance recording will be essential.

The existing animal agriculture strategies do not promote public understanding and awareness on the roles and values of farm animal genetic resources and the need for sustainable development and conservation. The government’s initiatives to conserve Tswana cattle sheep and goats have been disseminated through trade fairs, seminars and workshops. The National Advisory Committee on Farm Animal Genetic Resources was established to advise government on how best it can promote sustainable development and conservation of animal genetic resources. The Committee has the task to come up with the strategies that promote public understanding and
awareness on the role and value of animal genetic resources. There are several forums such as the Livestock Industry Advisory Committee that provides opportunities for the dissemination of information on the important role of farm animal genetic resources. The extension agents that are well distributed across the country can also be targeted and provided with properly packaged information stating the importance of animal genetic resources and how best the resources can be utilized, so that this information can be disseminated to the wider public. FAO may assist with expertise on how to package this information and advise on dissemination strategies.

4.3.2 Obstacles

In Botswana the constraints that limit the increased use of animal genetic resources relate to Tswana cattle, ostriches, rabbits, Tswana chickens, geese and ducks. Tswana cattle are underutilized due to lack of proper promotion of its attributes and productivity. Farmers must be made aware that this breed is productive and can also be used for crossbreeding with larger breeds. As for ostriches most farmers lack the knowledge because it is a new enterprise but it also requires a lot of resources in terms feed, veterinary care, and fencing material. In addition domesticated ostriches are not easily available. The rest of the species are not utilized because farmers do not know how to keep them and there are limited extension workers that can provide the information. One of the obstacles is lack of popular press by scientific journalism in Botswana to write about animal genetic resources and also the fact that a significant proportion of the population is illiterate.

There are also constraints to the genetic improvement of the above-mentioned species because there are few animal breeders in the country and lack of facilities such as laboratories (for processing semen, embryo transfer and storage). The absence of performance recording schemes within the country for other species except beef cattle is a major constraint to genetic development. There are no major policy constraints except for lack of legislations to regulate performance recording schemes and the operations of breed societies. Farmers are not allowed to import ostrich strains that are different from the indigenous strain. This is done to protect local strain from contamination but it also deny farmers a chance to crossbreed and take advantage of heterosis.
Botswana has no existing plans to utilize species that are not currently found within the country and there are no locally adapted breeds that have globally unique characteristics.

The Southern African Development Community (SADC) must create structures or institutions that will promote the use, development and conservation of animal genetic resources and also train relevant personnel to provide services to the farming community. Harmonisation of legislation and policy needs to be put in place to facilitate interaction between countries. In addition the regional SADC must provide shared facilities that can be used such as biotechnology laboratories in order to build on current SADC/FAO/UNDP project. SADC can also create a gene bank where member states may deposit genetic material (semen and embryos) of their indigenous livestock.
5.0 THE STATE OF THE CONSERVATION OF FARM ANIMAL GENETIC RESOURCES.

The National Conservation Strategy Agency is responsible for the conservation of biodiversity and has designated DAR to serve as a focal point for the conservation of farm animal genetic resources. An Advisory Committee on Conservation of Farm Animal Genetic Resources has been established and its major role is to advise government on strategies and programmes that promote conservation and utilisation of farm animal genetic resources. Following research findings that showed that Tswana sheep, goats and cattle are good breeds for meat production DAR established herds /flocks to further select these animals for better reproduction, growth and mothering ability. In addition DAR is now renovating a farm for conservation of breeds of other species such as chickens, pigs, horse. A laboratory is also being developed for cryo-conservation of genetic material such as semen, embryos and DNA material.

The Department of Animal Health and Production through the Pig Section is in the process of purchasing Tswana pigs, which are going to be maintained pure in a government farm. In addition the Poultry Section will be monitoring the performance of indigenous poultry and ostriches under a controlled production environment during the coming National Development Plan (NDP 9: 2003-2009). Though not formally involved in conservation of indigenous animals farmers are playing a vital role since they are a source of these animals, such as small ruminants, chicken, and pigs.

5.1 Conservation

The government is aware of the need to conserve farm animal genetic resources. This is why Botswana ratified the Convention on Biological Diversity, which means it is obliged to conserve animal genetic resources. The Minister of Agriculture, Hon. J. K. Swartz, stressed this point in his speech in Parliament when presenting the budget for the Ministry, on the 25th February 2003. He said “ Also the Ministry is creating awareness about the dangers of destroying indigenous livestock breeds and the need to conserve and safeguard them for the future environmental changes and market needs.” This demonstrates that at government level the need to conserve animal genetic resources is well understood and appreciated. There are a few sheep and goat farmers who also proposed a project for the conservation of Tswana sheep and goats. However
the majority of the farmers have not yet seen the need to conserve indigenous breeds and this is
demonstrated by their preference for exotic breeds of cattle sheep and goats. There are high
demands for Boer Goats and Dorper sheep in the auction sales organised by the Ministry of
Agriculture, Small Stock Section. Market trends have decreased the demand for indigenous
chickens and pigs.

There are no harmonized strategies by government to promote awareness and understanding of
roles and values of animal genetic resources particularly indigenous breeds. There is little
complimentary efforts by the extension departments to promote indigenous breeds, for instance
the Small Stock Section supplies exotic breeding stock. There are currently attempts to develop
niche markets in Europe for donkey meat, ostrich meat and skin but the ostrich and donkey
breeds are not at risk at the moment. It is hoped that as this industries grow these species will be
utilized more for food and agriculture. Some non-governmental organizations such as Centre for
Research and Development (CORDE) are working on the development of specialty markets for
indigenous poultry meat. It is argued that some Batswana prefer the taste of indigenous chicken
and as such there is potential market for indigenous chicken, which is currently ignored by
commercial farmers. Except for ostriches, chicken and donkeys there have been no attempts to
develop niche markets or specialized products to support the conservation of breeds at risk.

The objective of DAR’s initiatives to conserve Tswana cattle, goats and sheep is economic
because selection is based on economic traits, better growth rate, good mothering ability and
better reproduction and reduced mortality. It is envisaged that conserved Tswana cattle, sheep
and goats breeds will be mainstreamed in the commercial production systems. The strength of
this strategy is that commercialisation of these breeds will lead to their increased demand and
thus prevent their extinction. However selection within the breed may limit the diversity within
the breed and as a result the breeds may loose some of their characteristics that are not seen as
important at the moment. The other limitation of this initiative is that other species were
marginalised. Farmers have no role to play in this initiative because selection is within a closed
nucleus system. It is worth to consider involving farmers, even through subcontracting them to
conserve indigenous breeds for a price.
As for other species the strategy is to have the animals in one conservation farm. This will be for research, education and to maintain breeds at risk for future use. The breeds will be characterised in terms of physical traits and production traits. The advantage of using a conservation farm is that it allows for characterisation of breeds within a controlled environment. The danger of the conservation farm is that natural disasters such as floods, disease outbreaks may result in drastic losses of animals. At the moment the priorities of which species to conserve in the farm have not been made.

In addition to the in situ conservation strategies indicated above the strategy is to establish a laboratory (ex situ conservation) for cryo-conservation of semen, embryos, ova, cells and DNA material. The advantage of this system is that it saves space and can retain the material for a long time. In addition lost genotypes may be reconstituted if their genetic make up is known. This is an important system for conservation purposes and may facilitate easy exchange of genetic material and it serves as a gene bank.

Besides DAR, other Departments within the Ministry of Agriculture may take up other conservation activities. The major problem is that most stakeholders operate independently with very little coordination. The establishment of Advisory Committee on Farm Animal Genetic Resources was to assist coordination of conservation activities and set priorities on activities to be carried out.

The government funds conservation projects that are carried out by its various departments. Private farmers and companies have to look for funding elsewhere. The Global Environment Facility under the United Nations avails funds to private farmers for conservation of animal genetic resources and it is not open to private companies. There is guarantee that conservation projects funded by government will not run out of funds for the next five years but the same can not be said for private initiatives. The private sector (such as Botswana Meat Commission) can be encouraged to participate in the conservation of animal genetic resources through tax rebates and creation of funding mechanisms that are open to the private sector. The creation of legislation that protects the rights of a breed developer is another way of encouraging private initiatives. Finding specialised markets and engaging in product branding for indigenous livestock will promote different characteristic such as small cuts, unique carcass composition and flavour.
As reported in chapter 3 there are various factors affecting the security of various breeds across species. Tswana cattle are threatened by uncontrolled cross breeding. Tswana pigs lay down fat quickly and are not suitable for commercial lean meat production. Tswana chickens have slow growth rates and are not suited to commercial production system and exotic breeds are steadily replacing Tswana goats and sheep.

Culture, religion and social issues do affect the conservation of animal genetic resources. Tswana pigs are confined to the areas of Ramotswa, Tlokweng and Kgatleng districts because these people have a long history of keeping pigs and they eat pig meat. It has been observed that some religious denominations prohibit their members from eating pig meat. Modern mode of transport have rendered camels less useful as transport in the Kgalagadi desert environment and this has led to their disposal by the police department

Botswana has no mechanism to monitor the breeds that are at risk and thus is unable to update the DAD-IS database. There is little information (Rege and Tawhah 1999) to confirm that there were various strains or subtypes of Tswana cattle that now may be extinct or still present. (Podisi and Masilo 2001) indicated that there are other strains of Tswana cattle and goats found in the Chobe area. Breed surveys and molecular characterisation of breeds will confirm or refute this observation.

According to DAD-IS there is only one breed at risk and that is Botswana camels but there are other species that are under threat such as Tswana cattle. The rate at which Tswana cattle are reducing in proportion to the national herd is alarming. In 1994 Tswana cattle were estimated to be 50% of the national herd (Senyatso and Masilo1996) and the latest estimate in 2001 indicate they make just 40% (Masilo and Podisi 2001). Though DAR supply bulls to the AI laboratory for semen collection, the demand for semen from Tswana bulls is very low (see Table 2.6) an indication that the breed is not very popular. Semen from three Tswana bulls (DAHP 2000) is not popular and gets accumulated at the AI center; therefore these may be considered as conservation of some sort. However a planned strategy has to be put in place for this activity. No genetic material is stored for other species at the moment.

The government and multilateral organisations have increased their funding to conservation projects and as a result several new facilities are being established. The FAO/SADC project has
funded the development of Breed Field Guide, breed survey and has provided a computer and databases. The impact of conservation projects on agricultural production and food security is not yet visible because most of the projects have just been implemented.

The major disincentive for conservation projects is that they are not profitable in the short run so most of the private companies see no need to invest in them. As such it becomes a social cost to government. Commercialisation of the livestock sector brings in other breeds that are seen as more productive under controlled production systems and as such farmers abandon indigenous breeds. Most arable farmers no longer use cattle for draught power since tractors replaced animal power and as a result the multipurpose indigenous cattle are no longer preferred.

There is no information clearinghouse for farm animal genetic resources but the development of the National Biodiversity Strategy and Action Plan includes the establishment of such a mechanism. There is need to develop communication systems between organisations and farmers who are keen in the conservation of animal genetic resources particularly electronic management of information. Electronic communication is limited by the fact that not all agricultural extension area offices will be hooked on e-mail and that officers may not be computer literate. Farmer organisations also do not have computers. There is great potential for the development of the electronic network in the six agricultural regions within the country because most of the major villages are connected to the telephone network and are electrified. This will facilitate communication within the country and with the SADC region. Efforts must be made to hook agricultural regions to the focal point at the Department of Agricultural Research Head Quarters. Research on and documentation of traditional/local knowledge will facilitate the sharing and preservation of knowledge.

In conclusion, Botswana has limited human resources capacity and limited research capacity to effectively implement conservation programmes on animal genetic resources. Farmers must be involved even if monetary incentives are to be given because monetary benefits are reasons for commercial farming. In addition there are institutional/policy development constraints such as lack of breed societies and absence of legislation to regulate performance-recording schemes. So the country should prioritise human resources development in animal breeding, molecular biology, reproductive physiology, meat science and veterinary science. Compared to other SADC
countries Botswana has no comprehensive training facilities to support country’s expertise or high-level training programmes in the above-mentioned disciplines.

It is recommended that a follow up project to the current FAO/SADC project be developed to address issues of long-term training on animal breeding, molecular biology and other supporting disciplines. These should include the establishment of facilities such as biotechnology laboratories and regional gene banks. The countries must create a mechanism for exchanging information for breeds that are common and sharing of facilities. They should also develop common legislation to regulate exchange of genetic material.
6.0 THE STATE OF POLICY DEVELOPMENT AND INSTITUTIONAL ARRANGEMENTS FOR ANIMAL GENETIC RESOURCES.

6.1 Institutional Arrangement.

Livestock farming and management of farm animal genetic resources are portfolio responsibilities of the Ministry of Agriculture including newly domesticated species such as ostriches. However ostriches in the wild fall under the Ministry of Environment, Wildlife, and Tourism. The Ministry of Agriculture has two major Departments that deal with animal genetic resources, namely Animal Health and Production (DAHP) and Agricultural Research (DAR). DAHP is responsible for animal production extension and for disease control. It also facilitates the importation of semen into the country. DAR’s research only covers cattle (beef and dairy), sheep and goats. There are plans to introduce research on other species such as chickens, and ostriches. The Botswana Meat Commission is a parastatal that provides a market for beef cattle and to a lesser extent sheep and goats. The Botswana College of Agriculture is responsible for training and also carries out research. Schools and vocational institutions and demonstration centers also keep animal genetic resources for demonstration and educational purposes. There are farmers associations such as Botswana Dairy Association, Botswana Poultry Association, Small Stock Breeders Association of Botswana, Botswana Pig Producers Association that promote the use and in some cases conservation of animal genetic resources. The general issues of conservation are the responsibility of the National Conservation Strategy Agency (NCSA), which falls under the Ministry of Environment, Wildlife and Tourism. The NCSA is the focal point for the Convention on Biological diversity.

The major limitation with this institutional set up is lack of coordination and networking. DAHP only regulates importation of live animals, semen or embryos if there is a risk of introducing major economic or notifiable animal diseases e.g. foot and mouth or mad cow. Besides for fear of introducing disease there is no quality control mechanism to establish if semen or live animals may carry undesirable gene. These activities are not linked to research at DAR. At the same time the country is not able to regulate the exportation of animal genetic resources and as such run the risk of becoming victims of biopiracy. The establishment of the National Advisory Committee on Farm Animal Genetic Resources that consists of major stakeholders such as
farmers, government officials and major parastatals was mainly to help the government come up with policies and regulations that can assist the coordination of the use of animal genetic resources. This committee, appointed by the Minister, operates under the auspices of the DAR and thus may not have the necessary clout to influence government policy. Botswana is still to develop a National Action Programme on the Convention on Biological Diversity. Under this convention there are provisions through which Botswana can protect its indigenous breeds from biopiracy.

6.2 Policy development.

Botswana does not have a policy on the use, importation or exportation of animal genetic resources. The Department of Agricultural Research is in the process of proposing a policy on the conservation of animal genetic resources. The normal process of policy development involves consultation with all stakeholders including farmers but it is the responsibility of management of the Ministry of Agriculture. The Ministry of Agriculture has created various forums through which stakeholders can contribute to policy development and these are The Livestock Industry Advisory Committee, High Level Consultative Council, Policy Advisory Committee and the Animal Genetic Resources Advisory Committee. However, the farmers in most cases are not organized and as a result fail to contribute meaningfully in policy formulations. Farmers associations that were mentioned earlier are at different stages of development and some are still to develop effective grassroots structures that will facilitate communication within the organization. There is need to build the capacity of farmer organizations to enable them to effectively contribute to policy formulation. It must also be emphasized that a good policy is informed by good technical information and thus there is need to research more on animal genetic resources to gather information on the state of animal genetic resources, their characteristics, and the indigenous knowledge about their management and use.

6.3 Legislation relating to farm animal genetic resources.

There are several laws that in one way or another affect the utilization of animal genetic resources. Botswana is currently reviewing the Registration of Livestock Act that currently requires breed societies to register in South Africa. The new proposal is to have a legislation that controls performance recording, register and monitor breed societies, register and monitor
inseminators, regulate collection of semen and embryos through a livestock improvement center. The review process has taken too long. The absence of breed societies has made it difficult to monitor animal genetic resources and has also discouraged investments from potential stud breeders. Registered animals are marketable because customers are assured that they are buying an animal that is true to its breed and registered cattle get better compensation if they are killed by wildlife. Another advantage of breed societies is to market products of their breeds through breed branding. The current Registration of Livestock Act disadvantages breeders that keep indigenous cattle (that can not be registered in South Africa).

The Diseases of Animals Act (cap 37:01) allows the DAHP to prohibit importation of livestock from areas that are known to have major diseases. This legislation has prevented the free movement of certain livestock within the country, particularly cattle from foot and mouth infected areas. This act has also prevented the importation of certain breeds of cattle found in some African countries but with potential such as Boran from East Africa. However it must be noted that this act has assisted the country to access international lucrative beef markets.

Copyright and Neighbouring Rights Act: Act No 8 of 2000 does not extend to livestock and Industrial Property Act: No 14 of 1996 is not specific to livestock and as a result there is concern that our genetic resources are not well protected because in some countries livestock breeds can be patented. However, it must be admitted that patenting breeds may deny small farmers access to breeds of livestock that are well suited to their environment because they cannot afford the price. There is need to reward innovation so the country must come up with a legislation that protects breeders. At the same time care must be taken to protect farmers’ right to access the breeds that are indigenous or derived from the indigenous animals found in their area.

The Botswana Meat Commission (BMC) grading system is regulated and implemented by the DAHP. Heavier animals attract higher prices per kilogram of meat and therefore there is concern that the BMC pricing system is biased against medium sized animals like the indigenous Tswana. The carcass grading system also rewards breeds that have good marbling characteristics, which are mostly European breeds.

There is need for legislation that deals with genetically modified animals. The use of biotechnology in animal science has created opportunities for developments of genetically
modified animals but there are also threats that this innovation may end up producing livestock products that are not safe for human consumption. There are also ethical issues that must be considered such as whether it is right to introduce human genes in livestock. At the moment there is no legislation regulating the use and production of genetically modified livestock and as globalization intensifies the country will soon find itself confronted by these issues. There are efforts to develop National Biosafety Framework, which is going to encompass livestock, and DAR will be the national competent authority.

6.4 Animal genetic resources activities.

There are several activities carried out by different stakeholders on the management or research on animal genetic resources but as indicated previously the activities are not coordinated. There is no public fund for funding private initiatives for conservation of indigenous breeds. The Global Environment Facility-Small Grants Program funded the Conservation of Tswana goats and sheep by the Small Stock Breeders Association of Botswana.

The Department of Agricultural Research is selecting indigenous Tswana cattle, sheep and goats for meat production. These animals are kept in government farms and excess stock is sold through public auction to the farmers or any interested buyer. Lately the Department in collaboration with farmers, Botswana College of Agriculture has also carried out a physical characterization of Tswana sheep and goats and the results will be publicized in the near future.

The Department of Animal Health and Production has also carried out a survey on indigenous chickens and documented their physical characteristics. Plans are now underway to evaluate the productivity of these chickens under controlled management. AI facilities at Impala will facilitate the distribution of semen from AI bull stud at Ramatlabama.

There are other species such as donkeys, horses, camels, rabbits, geese, ducks that have not been studied in terms of the various breeds found in the country, their physical characteristics, productivity and distribution across the country. The other gap in research is that the breeds that are found in this country have not been genetically characterised using molecular tools and as such it cannot be established if there are several strains or if the breeds are unique to Botswana. A breed survey has been done, which will establish breed distribution across the country.
Graduates of agriculture come mainly from Botswana College of Agriculture (BCA), University of Botswana and some of the Education Training College. For a long time the BCA has offered training at diploma level on Animal Production and Health. In August 2002 the college started a degree in animal science and one hopes that it will have enough time to introduce subjects such as conservation and characterization of animal genetic resources. The college is also in the process of introducing postgraduate training, which hopefully will allow students and lecturers to research more on animal genetic resources. It is also assumed that facilities for molecular biology will be provided. At the moment graduates in veterinary and specialized post-graduate training in animal breeding, molecular biology and reproduction physiology are offered outside the country.

6.5 Investment in importation of exotic breeds.

The Animal Breeding Section of the DAHP facilitates the importation of cattle semen for farmers that do AI. The semen is also subsidized to help farmers afford improve genetic materials of fast growing breeds. There is no monitoring in terms of how the progeny of AI bulls do in terms of their survival and growth rates in communal production system. The importation of semen and live bulls has resulted in uncontrolled cross breeding of beef cattle and as a result the indigenous Tswana cattle are under threat.

Government programs such as Financial Assistance Program that was meant to diversify the agricultural sector and has also resulted in the increased use of foreign breeds of chickens for the broiler industry, dairy cattle, goats, sheep and pigs. The positive effect of FAP has been that the broiler industry grew substantially to a level of meeting the domestic demand. The negative impact of FAP in small stock was to create an impression that associates commercialization with foreign breeds. For instance sheep and goats farmers are now resorting to Dorper sheep and Boer goats. These exotic breeds are not well adapted to the environment and are less productive compared to Tswana breeds.

6.6 Gender and youth issues.

There are several programs that are run by the Botswana National Youth Council that assist youth to start livestock farming enterprises. However the Ministry of Agriculture does not have specific programs for youth except a few 4B projects. Relatively women participate more in poultry
farming and in goat farming and not so much in cattle farming. There is need to develop a strategy for involving women in beef farming because it can improve their standard of living. The Programs such as FAP had special dispensations for women such as higher grants.

6.7 **Capacity building in the management of animal genetic resources.**

The national priorities on capacity building on animal genetic resources are not easy to state because various institutions involved in management of animal genetic resources operate independent of each other. The priorities are therefore based on the stated gaps in training and research. Top on the list is specialized training on molecular biology, which will help the genetic identification of the breeds found in this country. This is a long-term training to masters or doctorate level. At the moment there are a few animal breeders, geneticists, reproduction physiologists and meat scientists, and therefore there is need to train more to support management of animal genetic resources. Other short courses can be organized for statistical sampling, database management and geographic information systems.

The focal point for conservation of animal genetic resources (Department of Agricultural Research) is hooked on the FAO databases of DAD-IS and it must disseminate some information to other stakeholders through newsletters or government magazines such as Agrinews. A strategic plan document needs to be developed on how this information will be shared. Local databases on existing animal genetic resources must be developed to document indigenous knowledge and population trends of local breeds. FAO may assist by short-term attachments of experts to help the country develop its database.

6.8 **Bilateral and multilateral arrangements.**

Botswana has undertaken collaborative work with International Livestock Research Institute (ILRI) in molecular characterization of its indigenous breeds. It also has undertaken bilateral project with FAO to conserve the indigenous breeds through a SADC/FAO project. The purpose of the project is to build the capacity of SADC countries to conserve and characterize all breeds found in the Region. The benefits are Botswana has received training and equipment to promote conservation of animal genetic resources. The only limitation is that the DAR some times does not attend training sessions and meetings due to financial limitations. The Department must
budget for these meetings so that the country can benefit from the information dissemination coming from these meetings.
References:


