Animal genetics strategy and vision for Tanzania

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TANZANIA LIVESTOCK MASTER PLAN BACKGROUND PAPER

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Animal genetics strategy and vision for Tanzania

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1. Introduction

Tanzania is endowed with abundant natural resources including land, water, forages and a large livestock herd. The country ranks third in terms of cattle population in Africa after Sudan and Ethiopia. Despite this large population, however, livestock's contribution to the national economy has not been significant.

In 2012, based on the National Economy Survey (URT, 2012), the livestock sector contributed 3.3% to the country's GDP. The sector grew by 3.1% in 2012, compared to 3.5% in 2011, and grew by 2.4% in 2015 (URT 2015). This level of growth is much lower than the 9% growth rate that is projected in the National Strategy for Growth and Reduction of Poverty (URT 2010) and is attributed to poor production performance attributes due to low growth and high mortality rates, low reproductive rates, and poor product quality. Modest improvement of these production coefficients coupled with value addition through processing could significantly increase output and income from the livestock industry.

The objectives of this report are

1. To describe the management and use of animal genetic resources in Tanzania through an inventory of the country's animal genetic resources using national and international data from the Food and Agriculture Organization of the United Nations (FAO) Domestic Animal Diversity Information System (DAD-IS), and the International Livestock Research Institute (ILRI) Domestic Animal Genetic Resources Information System (DAGRIS) and by describing the characteristics of these resources and their level of use in the different production systems (grassland system, mixed rain-fed system, mixed irrigated system, and others) in the country.
2. To identify the local policies for genetic resource management by analysing the strategies and intervention methods for conserving and selecting local breeds, on one hand, and for importing and using improved genes, on the other hand.

2. Rationale for characterizing animal genetic resources in Tanzania

Globally, industrial livestock operations are growing twice as fast as traditional mixed farming systems and six times as fast as traditional grazing systems (FAO 2006). To keep with this pace, and to meet the growing need, there is a strong move to depend on few specialized livestock species and breeds. This neglects the emphasis on improving the productivity of local breeds, and thus developing countries, including Tanzania, are not able to meet the food demands of the increasing human population using local breeds. This is because livestock productivity is too low to sustain the increasing human population (FAO 2015). This situation is further compounded by the fact that more than 20% of domesticated animal breeds in the world are at risk of extinction (Lokhit and Ilse 2005), and globally, the rate of losing animal genetic resources is an average of one breed per month (FAO 2006 cited in FAO 2015). The loss is further aggravated due to disasters such as prolonged drought, emerging epidemics and sporadic diseases, which are associated with climate change (FAO 2007 cited in FAO 2015). In Tanzania, some of the vulnerable indigenous breeds could disappear before anything is known about them.

In this context, there is compelling need to determine the extent of differentiation among livestock breeds at phenotypic and molecular levels. In this study, the focus is on the phenotypic characterisation, parameter estimates, and documentation of the local policies and interventions. This lays the ground for setting up of conservation priorities for indigenous livestock breeds in Tanzania.

3. The Livestock Sector Investment Toolkit (LSIPT) as a tool to characterize animal genetic resources in Tanzania

The genetic potential of animals used by producers is an important component of herd productivity and its adaptation to the constraints of livestock production. Critical evaluation of local and exotic breeds in the country and improvement attempts and plans is crucial to achieve the intended result.

This evaluation aimed to support the development of suitable genetic improvement strategies after assessing the animal genetic resource of the country; and evaluating different programs and policies planned and/or already practised. The Livestock Sector Investment Toolkit (LSIPT) was used to generate information required on the genetic animal resources. The animal genetics tool in LSIPT assisted in:

- Inventorying and characterization of animal genetic resources in Tanzania
- Reviewing of interventions in genetic conservation and improvement
- Identifying the local policies for genetic resource management

The methods used included data collection to fill in the genetics tool as well as literature review to document the policies and interventions on management of livestock genetic resources.

Methodology employed to characterize animal genetic resources in Tanzania

i. Inventory and characterization of the animal genetic resources in the Tanzania

- Desk review of secondary data from web-based sources using DAGRIS, DAD-IS, and published documents on breeds, breed characterization and parameter estimates in Tanzania.
    - The Excel file (m4_sm2_a5_TOOL_genetic.xlsm) contained four sections and was filled as described below.
        - Characteristics of genetic resources: Provided an overview of animal genetic resources in the country.
        - Representativeness of breeds/genetic types: Allocated the numbers of the genetic types in the main livestock production systems described in M3-SM1-A1, according to the country's livestock production typology.
        - Technical and economic parameters that characterised the production potential of the genetic resources. Where possible, the production potential of the genetic resources in the livestock production systems was characterized where these resources were used, according to the classification previously defined. Information was collected on productivity by number (fertility, prolificacy, mortality), the productivity by weight (average weight of the different categories of animals), or by yield (milk) and the animals' commercial value.

- An inventory of programs i.e. conservation and cross-breeding that were planned and being implementation was provided.

ii. Desk review to find out about the local policies for genetic resource management.

- Described the regulations adopted by animal genetic resources stakeholders.
- Drew up an inventory of the collective structures set up for managing breeding animals (conservation structures, breeding schemes, crossing schemes, and artificial insemination centres), which facilitate producers' access to quality genitors.
- Described the context of the health regulations governing the circulation of breeding animals or genetic material (semen, embryos).

4. Characteristics of the animal genetic resources in Tanzania

It is estimated that 90–98% of Tanzania's livestock are indigenous types that have low genetic potential, and hence, low productivity indices (URT 2012; URT 2013). Where there is potential for increased productivity, poor management systems prevent livestock keepers from achieving their goal of improving their livelihoods.

Although the Tanzania indigenous livestock are of low genetic potential, they merit well in terms of resistance to diseases. Resilience to diseases, community preferences and high twining rates in small ruminants, are the characteristics considered in animal genetic resources (AnGR) programs that focus on breeding and conservation.

The important species and their respective breeds as per the characterization tool of the LSIPT are cattle, sheep, goats, pigs and poultry, mainly chicken (see Annex 1). The mapping of these breeds/breed types, and level of use in different livestock production system typology is summarized in subsequent sections.

Cattle

The total population of nine breeds of cattle in the country such as Tanzania Shorthorn Zebu, Sanga (Ankole and Fipa), Mpwapwa, Boran, Ayrshire, Friesian, Jersey, Sahiwal and their crosses is approximately 26 million animals. These breeds are well maintained and their numbers are increasing, apart from the Mpwapwa breed, which is endangered. The main livestock products are meat, milk, drought, hides and blood. Also indigenous cattle breeds are used in traditional festivals. All cattle breeds, except the Boran and Sahiwal, are found almost in all production typologies: lowland grazing (LG), mixed production (MR-Coastal and Lake) and highland (MI) zones. The pure Boran is found in the LG, while the pure Mpwapwa breed is found in the LG and MI. To a large extent, the Tanzania Shorthorn Zebu is found in every typology; while the exotics breeds are mainly found in MR and MI. At present, conservation and selection programs on local breeds involve Tanzania Shorthorn Zebu, Mpwapwa, Sanga and Boran (see Annex 2).

Parameter estimates show that local and exotic breeds have annual parturition/calving rates from 0.61–0.67, respectively. Generally, the annual mortality rates are higher in local breeds than in exotics—ranging from 2–20% for local breeds and 2–10% in exotic breeds. Levels of management affects breed mortality. For adult local breeds of cattle, live weights range between 260–380kg, compared to 350–400kg for adult exotic cattle breeds. Dressing percentage ranged between 51–53%. Prices for adult live animals is higher for exotic breeds (TZS 1,500,000–3,000,000) compared to TSZ 500,000–1,000,000 for adult local breeds. It is indicated that milk production for most of the exotics dairy cattle in Tanzania ranges from 1550–2,200 litres per lactation period (305 days), with an average of 1990 litres of milk per lactation, while the local breeds' milk production is between 1200–2700 litres that gives an average of 517 litres per lactation (250 days). Thus, for a lactation period of 305 days, indigenous cattle breeds could produce 630 litres per lactation.

Sheep

The total population of sheep in the country is 8.7 million comprising four breeds namely: Blackhead Persian (BHP) as an exotic breed and indigenous breeds such as East African Blackheaded, Red Maasai and Tanzania Long-tailed breeds, which are found in all typologies (LG, MR and MI) at different proportions. The Red Maasai population is maintained but the population of the rest indigenous sheep breeds is increasing. The main products from sheep are meat, skins and blood only; the wool sheep do not thrive in Tanzania. Indigenous sheep breeds are also used in traditional festivals and rituals. They are well adapted to the environment making them resistant to drought and diseases, though exotic breeds are more productive despite being less well adapted to the environment. Sheep conservation and selection programs at present are focused on the Red Maasai (see Annex 2).

Parameter estimates show that local and exotic breeds have a near similar parturition/lambing rate that ranges from 1.5–1.6. Local breeds have slightly higher prolificacy rates (1.2) than exotic breeds (BHP sheep) which have a rate of 1.1. Generally, the mortality rate is slightly higher in local breeds than exotics; it ranges from 2–7% for local breeds and 2–6% in exotic breeds. This might be due to breed differences as all are kept in the same environment under similar management practices. The exotic breeds are heavier than local breeds with estimates showing body weight of 47–50kg for adult exotics, and 38–40kg for local adults. Dressing percentage is higher in exotic breed (50%) compared to the local breeds which is between 45–47%. The average price for adult exotic breed ranges from TZS 80,000–90,000, while that of local breeds ranges from TZS 60,000–80,000.

Goats

The total goat population in the country is approximately 17 million comprising seven breeds (Small East African-SEA, Malya, Anglo-Nubian, Boer, Norwegian, Saanen, Toggenburg and their crosses) which are found in all typologies (LG, MR an MI) in different proportions. According to Livestock Sector Analysis (LSA) done by TLMP (2016), the main products from goats are meat, milk, skins and blood. The use of indigenous goat breeds extends to traditional festivals and rituals. Indigenous breeds are highly adapted to the environment and are resistant to drought and diseases while exotics are prone to drought and diseases but have higher productivity. Current goat conservation and selection programs focus on the SEA goats (Pare white, Gogo white and Sonjo), Malya and Boer breeds (see Annex 2).

Parameter estimates show that local and exotic breeds have similar parturition/kidding rates which is an average of 1.5. In local breeds, SEA has shown low prolificacy rates (1.3) than the Malya and exotic breeds which have an average of 1.5 prolificacy rate. The mortality rates are slightly higher in local breeds than in exotics. It ranges from 2–20% for local breeds and 2–12% in exotic breeds. This might be due to better management of exotic breeds compared to local breeds. The exotic breeds are heavier than local breeds with weight ranging from 49–70kg for adult exotics compared to 38–65kg for local adults. Dressing percentage is similar for Malya goats and exotic breeds with an average of 50%. SEA goats have the lowest dressing percentage of 48% while Boer goats have the highest (53%). Prices for live animals are similar for Malya goats and exotic breeds with an average of TZS 150,000 per adult whereas for local (SEA) the price is TZS 80,000. Local breeds/types are used mainly for meat production while local Malya goats are used as a dual purpose breed for milk and meat. They produce 90 litres of milk per lactation (180 days) compared to an average of 500 litres per average lactation of 187 days in exotic breeds.

Pigs

The total pig population in Tanzania is 1.9 million, and comprises six breeds—Landrace, Hampshire, local Tanzanian, Saddleback, Large White— and cross-breeds. Their distribution along the typology (LG, MR an MI) is not known. The main pig products are meat and skin. Local breeds are highly adapted to the environment and are resistant to drought and diseases while exotics are less well adapted to the environment, are prone to drought and diseases but have higher productivity. No pig conservation and selection programs are currently ongoing.

Parameter estimates show that local and exotic pig breeds have a similar parturition rate of 2. Local breeds have low prolificacy rates (estimated to be 6), compared to exotic breeds that have prolificacy rates of 8–10. Generally, the mortality rates are slightly higher in local breeds (2–30%) than that in exotics (2–15%). This might be due to breed differences and better management of exotic breeds compared to local breeds. The exotic breeds are heavier than local breeds; with ranges from 72–90kg, and 55–60kg of adult live weights for local and exotic breeds, respectively. Dressing percentage (70%) is higher in exotic breeds compared to local breeds (60%). The prices for a local adult live pig is far lower than that of exotic breeds, with price of TZS 60,000 and TZS 150,000 respectively.

Poultry

The two main poultry production systems in Tanzania are traditional, that include indigenous chicken breed-types such as Kuchi, Bukin, Kawaida, Kinyavu, Kishingo, N'zenzegere, Singamagazi and Ching'wekwe, and commercial systems which include exotic breeds such as Black Astrorp, commercial broiler hybrids, commercial layer hybrids, White Leghorn, Light Sussex, Rhode Island Red and theirs crosses with indigenous breeds. The total population of poultry in the country is 76.5 million. Their distribution along the different typologies (LG, MR and MI) is not known. The main products are meat and eggs and the local breeds are also used in traditional/cultural festivals and rituals. Local breeds are highly adapted to the local environment and are resistant to diseases; while exotics are less well adapted to local conditions but are more productive. There is an ongoing conservation and selection programs for the Kuchi, Horas, Kishingo, Kinyavu and Kawaida local chicken breeds (see Annex 2).

The mortality rates are higher in local chicken breeds (8–40%) compared to the exotics (2-5%), which could be attributed to breed differences and level of management. The live weight of adult chicken ranges between 1.2–1.5kg, and 1.2–1.6kg for the local and exotic breeds, respectively. Dressing percentage is slightly higher (85.5%) in exotic breeds, compare to that of local breeds, which averages 80%. Price differences were noted between the adult local and exotic chicken with values ranging from TZS 4,000–10,000 for local chickens and TZS 6,000–8,000 for exotics.

5. Local policies and intervention methods

The Agriculture and Livestock Policy of 1997 guides the Tanzania agricultural sector. The policy addresses agriculture and its crop and livestock sub-sectors well, but industry specific guidelines are not clearly spelled out, and issues of conservation of indigenous livestock resources are not adequately addressed. For example, a national workshop of livestock stakeholders in Arusha, in 2001, found that the statements in the policy on provision of improved livestock breeds were too general and did not give clear guidelines to enable stakeholder participation in the production of these breeds.

Nevertheless, the policy document adequately covers other livestock issues, such as improved livestock management including the provision of adequate land for grazing, good feeding including provision of adequate water, control of animal diseases and parasites, provision of veterinary services and drugs, provision of infrastructure, slaughterhouses and preservation of livestock products. Guidelines on market information generation and dissemination, provision of other services such as research, extension and education and soliciting the participation of the private sector in the industry are also well spelled out.

The policy contributed to the establishment of the Ministry of Livestock Development in 2006. The ministry then came up with its own National Livestock Policy (NLP) in the same year. However, the NLP does not give the required emphasis to animal breeding issues. Only one section (3.9) outlines that 'good quality breeds are an important input for increased livestock productivity. However, most of the national herd is characterized by animals of low genetic potential resulting in low production and productivity. Nevertheless, some animals possess desirable characteristics such as good mothering ability, high prolificacy and growth rates. Genetic improvement of these animals can result in increased productivity. The development of Mpwapwa breed and blended goat are examples of these efforts'.

Furthermore, according to this policy (URT 2006), animal breeding is constrained by inadequate expertise and infrastructure, insufficient improved genetic resources, and lack of livestock breeders' associations and societies. Thus, the policy envisions, the objective is to enhance genetic improvement of livestock to increase production and productivity. It ends with the following policy statements:

i. The government will promote livestock breeds inventory, characterization, evaluation and genetic potential improvement.

ii. The government will strengthen technical support services in animal breeding.

iii. Efforts will be undertaken to promote breeders' associations, clubs and breed societies for sustainable conservation and breeding.

The 2006 NLP lacks well-defined principles for breed selection, cross-breeding and introduction of pure-breeds in accordance with agro-ecological conditions and prevalent management levels in the country. The general strategy in animal breeding should focus on optimization of genetic potential according to production factors, the needs of the market, the ecological environment and future development (Wollny 1995). In low input-output systems, the sustainability of animal breeding efforts to improve animal productivity becomes a dominant factor (Wollny 1995), hence selection should be practised within the adaptive environment and under sustainable management conditions

(Valle-Zárate 1996). There is therefore a strong need to develop a clear animal breeding policy which will put more emphasis on selection and breeding of suitable genotypes for the different production systems.

In 2008, FAO organized a workshop on 'Formulation of policies and strategies for the development of animal genetic resources in Tanzania', which emphasized the importance of an animal breeding policy in Tanzania. Such a policy would guide improvement of indigenous livestock resources to meet the economic and nutritional need of the present generation and assist partly in conserving livestock for future generations.

Another policy relevant development was the output of a National Report for the United Nations Conference on Sustainable Development, Rio+20, published by the Vice President's Office, Division of Environment, United Republic of Tanzania, Dar es Salaam, 2012, that gave recommendations on how to develop the livestock sector. The conference also helped set the national vision for this sector in line with Tanzania's Vision 2025 which aims to have, 'by 2025, a livestock sector which to a large extent shall use well-bred and productive livestock that are commercially used in a sustainable way to contribute to the improved nutrition and well-being of all the livestock keepers and all Tanzanians in general without causing harm to the environment'.

Despite the few efforts noted above, to date, there is a lack of a policy document that can guide the interventions and address challenges of animal genetic improvement. There is need for a road map that will guide the establishment of a legal framework for regulation, coordination, and improvement of Animal Genetic Resources (AnGR) in Tanzania. In this context, an animal breeding policy is essential. However, with a national livestock policy already in place, the proposed Animal Breeding Act can facilitate the establishment of institutions that will coordinate AnGR activities in the country and enable implementation of the livestock sector development goals of the country's Vision 2025.

6. Future prospects

The World Bank, FAO, ILRI and the International Food Policy Research Institute (IFPRI) have predicted that by the year 2020 increases in livestock products in the developing countries could be more spectacular than those achieved for cereals from the 'Green Revolution'. Higher income are associated with increased protein intake of people, particularly in urban areas, and the expected higher incomes in these countries by 2020 will result in higher demand for animal products (SoW-AnGR 2004).

Currently, Tanzania is putting in place improved markets and communication infrastructure (roads, telephones and air transport) to facilitate the movement and sale of agricultural produce including livestock and livestock products. There is need, therefore, to urgently put in place a policy and strategies to ensure farmers have access to and keep more productive livestock species to increase the supply of livestock products for internal and external markets. It is for this reason that breeding programs that produce, in large quantities, species of animals and poultry including animals and birds that are currently neglected; such as donkeys, turkeys, ducks, geese, guinea fowls, guinea pigs, rabbits, ostriches, and fish (especially Nile perch, trout and tilapia) is being recommended in this policy.

Genetic improvement programs that use selected breeding animals can result in small but cumulative increases in efficiency of animal production. With adequate breeding strategies and plans, the small but cumulative responses to selection achieved in nuclei of males breeding herds or flocks are passed on to commercial herds or flocks. This potential for expression of small changes in traits such as milk yield, growth rate, eggs or meat output in thousands or millions of animals is what makes genetic improvement programs one of the most powerful and cheapest means of increasing efficiency of animal production. These efforts should be supported by the Animal Breeding Act.

Similar to breeding programs in dairy cattle, interbreeding between the Tanganyika Shorthorn Zebu and exotic cattle or cross-breeding between larger bodied animals like the Boran with exotic breeds of cattle can provide animal that produce more beef to bridge the current deficit in meat demand. Findings from research in Tanzania by Said et al. (2003) showed the possibility of achieving market weights of 350–450kg and 450–800kg from male cross-breeds of Friesian and Boran at four years of age, respectively, when the indigenous dams are crossed with exotic beef breeds like Angus, Charolais and Chianina.

7. Challenges

The management of AnGR is facing several challenges that hinder progress including the following:

i. Unmet community demands for improved breeds

Currently, only a few government research institutions and private farms provide improved breeding animals in the country. These institutions are unable to produce enough breeding animals to meet the demand for improved stock.

ii. Absence of a national recording system for selection and breeding programs

The former National Livestock Registry, based in Mpwapwa, ceased coordinating livestock recording in the early 1980s due to resource constrains. The system was also too complicated for rural livestock keepers to participate and access the information and it was difficult to run because of a lack of computers that could store and handle large data sets. However, if a simpler recording system that is easily manageable is developed and used, it could become the basis for identifying and selecting breeding animals for future genetic improvement programs. Such a system should be linked with the work of the Directorate of Livestock Identification Registration and Traceability.

iii. Poor coordination of animal genetic resources initiatives in Tanzania

There have been a growing number of exotic breeds imported into the country in terms of live animals, semen and embryos with little information on the pedigree, performance and guarantee that the imported animals do not come from farms harbouring genetic defects and zoonotic disorders such as mad cow disease. Trade in breeding animals among local institutions is done without proper performance records that would protect the interests of sellers and the buyers.

These and other challenges were observed in a 2013 workshop that assessed the status of livestock genetics in Tanzania (see Annex 3).

Tackling these and other problems affecting the livestock industry requires collaborative efforts between livestock sector stakeholders and the public and private sectors. Policy, infrastructure and procedural issues can be prioritized as short- to medium-term investments of one to three years. On the other hand, the more significant technical challenges such as enhancing livestock productivity and its contribution to the economy in the long-term need more detailed analysis and strategies. These efforts will also require financing from government and other partners.

8. Strategies in the next five years

Regardless of the strategies adopted for livestock improvement in the country, it is important to consider the genetic uniqueness of existing livestock breeds in country, particularly the indigenous breeds, their adaptive traits, the degree of endangerment, relative value for food/economic importance, their functional traits and their ecological, historical and cultural values.

The formulation of the Tanzania Livestock Master Plan (LMP), which is based on the Livestock Sector Investment and Policy Toolkit (LSIPT) will be a big step forward in supporting efforts at gathering comprehensive information on the country's animal genetic resources. The LSIPT tool for characterization of AnGR will be essential in setting benchmarks for further animal genetic improvement in the country in response to, for example, findings from using the tool that indicate that breeds' management and environment differences are sources of variation in production systems.

The LMP also needs to build on ongoing breeding initiatives on characterization of traits, utilization, risk of genetic erosion, productivity improvement, and conservation and farmers' livelihood improvement (see Annex 4). The government through the Tanzania Livestock Research Institute (TALIRI) is working with the Commission for Science and Technology (COSTECH) to increase capacity building for research institutions in conducting livestock genetics research and training farmers and experts. These initiatives will all contribute to AnGR improvement in the country in coming years.

9. Recommendations and way forward

Initiatives and interventions for improving animal genetics should focus on:

i. Strengthening selection and conservation in current animal breeding programs.

ii. Strengthening delivery and use of animal breeding technologies such as artificial insemination (AI), working with the Ministry for Education and Training, etc.

iii. Supporting efforts towards the establishment of a national animal breeding policy/act.

iv. Capacity building for experts and farmers in animal breeding, selection, conservation and recording.

v. Promoting establishment of breeding societies and associations including those led by the private sector.

vi. Enhancing local, regional and international networking for experience and technology sharing.

10. Conclusion

Despite their lower productivity, indigenous livestock possess desirable traits such as heat tolerance, adaptability to low-quality tropical forages and resistance to certain diseases. In addition, cross-breeding of indigenous breeds with exotics imported into the country since the 1920s has not led to significant large-scale genetic improvements. However, the National Livestock Policy 2006 and an envisaged Animal Breeding Act will provide pillars to further animal genetic resources improvement in Tanzania. An efficient and well-managed livestock improvement program in the country will enhance market-oriented livestock productivity, livestock conservation, and environmentally-friendly livestock production systems in the country.

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Annexes

Annex 1: List of livestock breeds: local, cross and exotics in Tanzania

Species	List of breeds	NBS-2013	2015 (DAD-IS and DAGRIS)		NBS-2016 (projection)	AnGR team 2016
			Range	Average		
Cattle	1. Tanzania Shorthorn Zebu	19,120,672				24,014,360
	Types/strains					
	Chagga		Extinct			
	Gogo		Extinct			Not extinct
	Iringa Red		313,500–400,000	356,750		
	Maasai		1,710,000–2,240,000	1,975,000		
	Mkalama Dun		Extinct			
	Mbulu		57,000–798,000	427,500		
	Singida White		1,100,000–1,368,000	1,234,000		
	Sukuma		2,000,000–3,200,000	2,600,000		
	2. Boran		9120–11,400	10,260		103,200
	Tarime		910,000–1,100,000	1,005,000		
	3. Sanga	3,976,737				1,062,440
	Types/strains					
	Ankole		1,140,000–1,710,000	1,425,000		
	Fipa		100,000–150,000	125,000		
	4. Ayrshire	70,898	50,000–70,000	60,000		61,920.00
	5. Friesian	182,257	650,000–700,000	675,000		133,840
	6. Jersey	8884	5000–10,000	7500		9,536
	7. Mpwapwa	3849	1000–2000	1500		800
	8. Sahiwal	1759	1000–2000	1500		2,384
	9. Crosses	615,820	Unknown	615,820.20		411,500
Total cattle		23,980,876		10,014,010	25,450,723	25,799,980

Species	List of breeds	NBS-2013	2015 (DAD-IS and DAGRIS)		NBS-2016 (projection)	AnGR team 2016
			Range	Average		
Sheep	1. Blackhead Persian	7687	5680–8528	7104		15,239
	2. East African Blackheaded	998,826	852,000–994,000	923,000		1,979,952
	3. Red Maasai	767,894	624,000–795,200	709,600		1,522,182
	4. Tanzania Long-tailed	2,614,478	850,000–1,000,000	925,000		5,182,627
	Breed: types/strains					
	Kasulu		Unknown			
	Man'gati/Mbulu		Unknown			
	Sukuma		1,278,000–1,704,000	1,491,000		
	Urambo		Unknown			
	Gogo					
Total Sheep		4,388,885		4,055,704	8,003,691	8,700,000
Goats	1. Small East African (SEA)	14,456,759				16,196,201
	Types/strains					
	Gogo		2,000,000–2,400,000	2,200,000		
	Luguru		Unknown			
	Maasai		1,650,000–2,000,000	1,825,000		
	Newala		320,000–340,000	330,000		
	Pare white		350,000–400,000	375,000		
	Sonjo Red		300,000–400,000	350,000		
	Sukuma		2,700,000–3,300,000	3,000,000		
	Ujiji		354,000–470,000	412,000		
	2. Anglo-Nubian	Extinct	1000–1200	1100		672
	3. Boers	1500	1000–1500	1250		1680
	4. Malya (blended)	9363	5000–6000	5500		1984
	5. Norwegian	1700	1200–1700	1450		1903
	6. Saanen	150	100–200	150		1680
	7. Toggenburg	3000	1200–3000	2100		3359
	8. Crosses	439,856	Unknown			492,521
Total goats		14,912,328		8,503,550	20,564,489	16,700,000
Pigs	1. Local Tanzania pigs		1,800,000–2,000,000	1,900,000		475,000
	2. Hampshire		Unknown			19,000
	3. Landrace		Unknown			95,000
	4. Large White		Unknown			133,000
	5. Saddleback		Unknown			38,000
	6. Crosses					1,140,000
Total pigs		335,000		1,900,000	1,968,758	1,900,000
Camels	Unknown breeds		Unknown			

Species	List of breeds	NBS-2013	2015 (DAD-IS and DAGRIS)		NBS-2016 (projection)	AnGR team 2016
			Range	Average		
Poultry	1. Indigenous chicken (Ind. c)	41,895,605				42,000,000
	Bukin		468,000–624,000	546,000		
	Ching'wekwe		Unknown			
	Kawaida		8,500,000–10,000,000	9,250,000		
	Kinyavu		1,800,000–3,120,000	2,460,000		
	Kishingo		500,000–1,000,000	750,000		
	Kuchi		40,000–50,000	45,000		
	Mbeya		Unknown			
	Morogoro medium		Unknown			
	Morogoron small		Unknown			
	N'zenzegere		Unknown			
	Pemba		Unknown			
	Singamagazi		Unknown			
	Tanga		Unknown			
	Unguja		Unknown			
	2. Layers					12,000,000
	3. Broilers					22,500,000
	Layers and broilers include:					
	Black Astrorp		1800–2300	2050		
	Commercial broiler hybrids		5,600,000–7,500,000	655,0000		
	Commercial layer hybrids		15,000,000–17,000,000	16,000,000		
	White Leghorn		Unknown			
	Light Sussex		5000–7000	6000		
	Rhode Island Red		Unknown			
	Their crosses		Unknown			
Total poultry		44,240,371		35,609,050	64,013,372	76,500,000
Rabbits	1. Black Satin		Unknown			
	2. California White		Unknown			
	3. Carolina White		Unknown			
	4. Chinchilla		Unknown			
	5. Flemish giant		Unknown			
	6. New Zealand White		Unknown			
Goose	1. Greyleg goose					
	2. White footed goose					
Guinea fowl	Guinea fowl					
Guinea pig	Guinea pig					
Horse	Horse					
Ass	1. Maasai donkey				575,541	
	2. Muscat					
Buffalo	Egyptian					

Annex 2: Brief success stories of animal genetic resources conservation in Tanzania

Conservation of animal genetic resources

Conservation of animal genetic resources (AnGR) refers to all human activities including strategies, plans, policies and actions undertaken to ensure that the diversity of animal genetic resources is maintained to contribute to food and agricultural production and productivity, or to maintain other values of these resources (ecological, cultural) now and in the future. In short, conservation of AnGR refers the 'sustainable utilization of AnGR' that maintains the gene pool.

There are two types of conservation of AnGR, which are in situ and ex situ.

In situ conservation

Conservation of livestock through continued use by livestock keepers in the production system in which the livestock evolved or are now normally found and bred.

Currently, there is no official or formal conservation program in the country. However, pastoral communities have managed to maintain this diversity through their rigidity to change their indigenous livestock for exotic ones. This has helped to come up with indigenous breed-types such as:

Cattle: Tarime, Sukuma, Singida White (Mkalama), Mbulu, Maasai, Iringa Red. Some communities could not afford to conserve their animals because of extinction of some breed types such as Gogo, Pare and Chagga.

Goats: Newala, Gogo White, Pare White, Maasai, Sonjo, Sukuma and Ujiji.

Sheep: Red Maasai, Mbulu, Gogo, indigenous Blackheaded Persian and Sangu

Poultry: There are no 'indigenous' chicken in the country that have been specifically selected and bred by unique communities. Rather, local chickens are found in different areas of Tanzania and their names do not refer to any community like in other livestock species. In this context, Tanzania has local chicken breed types such as Kuchi, Kawaida, Kishingo, Kinyavu and Bukini. The naming of these breed-types depended on their morphometric characteristics.

NB: Indigenous names refer to the communities like Maasai, Pare, Gogo while local refers to an area like Malya, Mpwapwa etc.

Ex situ conservation

There are two kinds of ex situ conservation—in vivo and in vitro.

i. *Ex situ in vivo conservation*

This is conservation through maintenance of live animal populations not kept under native management conditions (e.g. zoological parks and in some cases government or private farms) and/or outside of the area in which they evolved or are now normally found.

ii. *Ex situ in vitro conservation*

This is conservation external to the living animal in an artificial environment, under cryogenic conditions including, inter alia, the cryoconservation of embryos, semen, oocytes, somatic cells or tissues having the potential to reconstitute live animals (including animals for gene introgression and synthetic breeds) later.

Currently, there are conservation activities that need to be upgraded into either ex situ in vivo conservation or ex situ in vitro conservation program including:

i. Ex situ in vivo conservation

Based on their high rate of extinction, some livestock breed types considered as ex situ in vivo conserved in different research institutions are:

Species	S/no	Breed-type/breed	Conservation area	Total no (estimate)
Cattle	1	Mpwapwa	TALIRI-Mpwapwa	450
	2	Fipa	TALIRI-Mpwapwa and Uyole	300
	3	Ankole	TALIRI-Mabuki	380
Goats	1	Pare White	TALIRI-West Kilimanjaro	250
	2	Sonjo	TALIRI-West Kilimanjaro	200
	3	Malya (blended goats)	TALIRI-Kongwa	400
	4	Boers	Ngerengre farm	250
Sheep	1	Red Maasai	TALIRI-West Kilimanjaro	300
Chicken	1	Kuchi	TALIRI-Mpwapwa	140
	2	Horas	TALIRI-Mpwapwa	180
	3	Kishingo	TALIRI-Mpwapwa	120
	4	Kinyavu	TALIRI-Mpwapwa	100
	5	Kawaida	TALIRI-Mpwapwa	100

ii. Ex situ in vitro conservation

No layout has been made for this type of AnGR conservation as a program. However, to a small extent, semen conservation is done by AI centres led by the National Artificial Insemination Centre (NAIC) located at Arusha.

Annex 3: Challenges observed by the participants in a Bill & Melinda Gates Foundation (BMGF)-supported workshop on animal genetic resources in Tanzania

The report of Bill & Melinda Gates Foundation Livestock Genetics Investment Strategy Development, Tanzania Livestock Genetics Convening, 18–20 September 2013, in Arusha, Tanzania, noted the following AnGR challenges.

1. Involve farmers and encourage private sector participation in genetic improvement systems.
    - Targeting farmers with specific and accurate data and information and recording systems.
    - Addressing farmers' disaggregation and seeking their input and preferences in the design of genetic improvement systems to ensure sustainability.
    - Stimulating private sector investment in provision of inputs and services especially establishment of AI infrastructure and service delivery.
    - Encouraging private-led sector efforts.
2. Maintain/develop appropriate genotypes and streamline breeding efforts for better impact.
    - Ensuring proper and goal-oriented breeding, multiplication, delivery and regulation of germplasm.
    - Having well-worked out breeding strategies to address uncoordinated unsustainable breeding efforts.
    - Developing agro-ecological/management-specific genotypes.
    - Improving productivity without losing indigenous genotypes.
3. Establish reliable and sustainable germplasm delivery systems.
    - Developing and effectively operating infrastructure systems for sustainable germplasm delivery.
    - Improving AI service delivery including access to high-quality semen, and service providers.
    - Establishing reliable and cost-effective germplasm delivery system with wider coverage.
4. Sustaining intervention and optimize productivity in each environment.
    - Establish a recording system that allows animal evaluation – what animal breed for what environment?
    - Optimizing productivity in each environment.
    - Identifying/defining a production system.
    - Ensuring adequate and sustainable funding efforts.
    - Establishing long-term intervention programs.
5. Establish/strengthen institutional arrangements and policies for livestock genetic improvement.
    - Establishing strong institutional support for inputs and services i.e. capacity building, animal health, finance, etc.
    - Strengthening linkages/relationships between actors (researchers and farmers).
    - Establishing a forum to coordinate and harmonize breeding efforts.
    - Creating effective breeders' societies.
    - Establishing effective self-regulating genetic institutions.
    - Lobbying for a conducive policy environment.
    - Developing favourable breeding policy.
    - A clear breeding direction/plan and breeding policy objectives.
    - Proper implementation of existing policies and regulations.
    - Clear breeding goals and strategies.

Annex 4: Ongoing animal breeding projects in Tanzania

Ongoing animal breeding projects focus on characterization of traits, utilization, risk of genetic erosion, productivity improvement and conservation. They include:

i. Improving quality and quantity of beef by introducing modern rearing systems of beef cattle in Tanzania

This five-year project is implemented in four agro-ecological zones — the Lake, Central, Southern highlands and Western zones. The Tanzania Livestock Research Institute (TALIRI) Mpwapwa is providing technical coordination and financial implementation while TALIRI Mabuki is the lead centre and the four other institutes, depending on their agro-ecological zone status, are implementing the project in close collaboration with TALIRI Mabuki. The centres are TALIRI Mpwapwa (Central), TALIRI Uyole (Southern highlands) and TALIRI Kigoma (Western).

Its goal is to contribute to poverty reduction and improved food security in livestock keeping communities and the country at large by improving beef cattle productivity and beef products.

Specific objectives include:

i. Identification, characterization and conservation of indigenous species with beef production potential.
ii. Formulating and disseminating cost-effective beef-based technological packages.
iii. Improving and multiplying appropriate beef cattle breeds.
iv. Enhancing public private partnership in beef research.
v. Establishing, retooling and rehabilitating of beef research infrastructures in research institutes.
vi. Enhance collaboration with relevant international, regional institutions and development partners.

ii. Improving dairy industry productivity through use of appropriate dairy technologies in Tanzania

This is a five-year project coming being implemented in three agro-ecological zones namely: Southern highlands, Eastern and Central zones. TALIRI Uyole is the lead centre. Other TALIRI centres, Mpwapwa (Central) and TALIRI Tanga (Eastern) operate the project based on their geographical mandates.

It aims to develop and disseminate technically viable technologies to the dairy industry that will contribute to income and food security by improving dairy productivity, income and livelihood of livestock farming communities in rural areas

Specific objectives include:

i. Strengthening dairy cattle breeding and production research and improving coordination and networking.
ii. Developing and disseminating technological innovations for improving dairy cattle productivity and quality of dairy products.
iii. Conducting socio-economic studies on the introduced dairy technologies.
iv. Carrying out capacity building on human, physical and financial resources.

iii. Strategies to improve pig productivity, income and livelihood of livestock farming communities in the central and southern highlands regions of Tanzania

This project is being implemented in the Central (Dodoma and Singida regions) and Southern highlands zones (Iringa, Mbeya, Ruvuma and Rukwa regions) and is under supervision of TALIRI. The centre is responsible for technical coordination, implementation, and monitoring, as well as financial and accounting management of the project.

Its broad objective is to improve farmers' livelihoods through development and dissemination of technologies that will increase pig productivity, food security and reduce poverty.

Specific objectives include:

i. Developing pig production technological innovations (feeding, breeding and selection and management).
ii. Disseminating pig production technological innovations.
iii. Conducting socio-economic studies on introduced technologies related to pig production.
iv. Building capacity of researchers, farmers and other pig sector stakeholders and improving access to financial resources and physical infrastructure as well as technical materials to institutions.

iv. Improving livelihoods of farmers through enhanced productivity of sheep and goats in different agroecological zones of Tanzania

The project is carried out both on-farm and on-station. The on-farm activities are in 15 regions, but the benefits and effects of implementations are expected to spill over to other areas of the country. These zones and regions (in parentheses) include Central (Dodoma and Singida), Eastern (Morogoro and Coast), Northern (Arusha, Manyara and Kilimanjaro), Southern (Mtwara and Lindi), Lake (Shinyanga, Mwanza, Mara and Kagera) and Western (Kigoma and Katavi). The on-station activities will concentrate in four TALIRI centres namely: TALIRI Kongwa and TALIRI Mpwapwa in central zone, TALIRI Naliendele in southern zone and West Kilimanjaro in the northern zone.

It will contribute to poverty reduction and improved food security in livestock keeping communities of Tanzania by improving livelihoods of farmers through sustainable productivity of small ruminants.

Specific objectives include:

i. Developing environmentally-friendly breeding and feeding technologies for sheep and goat production and product processing.
ii. Disseminating developed technologies on sheep and goats to small-, medium- and large-scale farmers.
iii. Conducting socio-economic studies on small ruminant production and productivity.
iv. Improving physical and intellectual capacity in sheep and goat research.

v. Improving indigenous chicken production through supplementary feeding, breeding and management

The project covers the Central (Dodoma, Tabora and Singida regions), Lake (Mwanza and Shinyanga regions) and Southern zones (Lindi and Mtwara regions) which have the highest population of indigenous chickens in the country.

Its goal is to contribute to poverty reduction and improved household food security while contributing to the national economy. The general objective of the project is to improve productivity of indigenous chickens and enhance income and nutrition of households that will lead to improved standards of living.

Specific objectives include:

i. Developing appropriate feeding, breeding and management technologies that will improve poultry productivity.
ii. Disseminating feeding, breeding and management technologies to the end users for better utilization.
iii. Conducting studies on adoption rate and impact of the introduced technologies on the farmers' livelihood.
iv. Improving human resource capacity by providing tailor-made training to researchers, key stakeholders and equipping the institutes with scientific equipment and materials.

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