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Utilization, Collection and Conservation of Animal Genetics Resources in Relation to Indigenous Breeds

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Abstract: Indigenous breeds provide the necessary genetic diversity needed by modern agriculture as a means to ensure stability and are vital building blocks for future livestock breeding programmers. Farm Animal Genetic Resources (FAnGR) conservation, collection and processing procedures which different widely depending upon the type of germplasm being collected and the donor species. Due to indigenous FAnGR carry genes that enable them to tolerate harsh environments, cope with thorny vegetation in drought-prone areas, walk long distance and repel attacks by diseases and pests. However, these animal resources are constantly being eroded and are nearing extinction. Conservation is an action to ensure that the diversity of farm animal genetic material is being maintained for contribution to food production, two methods for the conservation of animal genetic resources in-situ conservation refers to conservation of livestock through continued use by livestock keepers in the production system in which the livestock evolved or are now normally found and Ex-situ (in vivo conservation): effective conservation of genetic resources is possible only if the breeds are identified and documented adequately. Therefore, conservation of FAnGR is useful for the sustainable utilization of genetic resources under different production environment and production system. In this regard, valuation of local breeds should consider their major contribution to risk management under the prevailing hard and fluctuating environmental conditions.

Key words: Collection, conservation farm animal, germplasm indigenous breeds, adequately, animal genetic resources, risk management

INTRODUCTION

The role and contribution of Farm Animal Genetic Resources (FAnGR) have often been overlooked as they had to compete against high input and output breeds. However, indigenous livestock species carry genes that enable them to tolerate harsh environments, cope with thorny vegetation in drought-prone areas, walk long distance and repel attacks by diseases and pests (Annoynoums, 2007). Indigenous breeds provide the necessary genetic diversity needed by modern agriculture as a means to ensure stability and are vital building blocks for future livestock breeding programmers. As such, conserving them is important, not only for the communities who keep the animals but also for the future of modern agriculture (National Reaserch Council, 1993).

However, these animal resources are constantly being eroded and are nearing extinction, one third of farm animal genetic resources contributing to rural lively hood are endangered as a result of various types of threats (Mulualem *et al*., 2015; Baldassarre and Karatzas, 2004).

Conservation of local breeds should be considered whenever the development of animal production systems is discussed. However, there are some factors that pre dispose breeds to the risk of extinction. Therefore, the objective of this study is that to synthesis utilization, collection and conservation of animals genetics resources in relation to indigenous breeds.

MATERIALS AND METHODS

Factors causing risk of loss and extinction of breeds

Population size: From a genetics point of view a population is not just a group of individuals but also a breeding group genetics of a population, therefore, is concerned not only with the genetic constitution of the

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individual but also with the transmission of the genes from one generation to the next. The risk to lose a certain gene increases dramatically in small populations (Jacquard, 2012). The principle effect of reduced population size is the associated decline in intra locus genetic variability within individuals (hete rozy gosity). This in turn is measured as the inbreeding coefficient (Falcorner *et al*., 1989).

Many studies have shown that functional traits deteriorate by 3-5% for every 10% increase in the inbreeding coefficient. In a random mating population of ne individuals with equal number of males and females and discrete generations, the increase in inbreeding per generation is a simple function of the population size: 1/(2N+1). However, domestic livestock populations do not mate randomly and they usually have many more breeding females than males. In these circumstances, the effective population size N is usually much lower than the number of animals in the population; -Ne = 4MF/(M+F) where M and F are the numbers of males and females, respectively (Falconer *et al*., 1989; Frankham, 1995).

Change in farming systems: Change in farming system often involves changed breeding objectives for livestock. In traditional systems, number of livestock rather than output per head if often the main consideration (Chagunda and Wollny, 2003). In these circumstances, traits related to survival in the face of nutritional, health and climatic stress predominate. As farming systems become more market oriented, volume and value of saleable product takes over and selection goals often change from multi-purpose use to much narrower targets (Alroe *et al*., 2001). The selection goals shift to such traits as prolificacy, early maturity individual growth rate and milk yield and aspects of milk composition and meat quality. Selection for such traits transforms the genetic constitution of the breed and also promotes inter-population gene flow through migration and crossbreeding (Kaosgey *et al*., 2006).

Cross breeding: Native breeds to particular countries or localities are often well adapted to the local conditions climate, nutrition, disease exposure. The breeds are rarely thought to be perfect in all respects and improvements in productivity are desired (Chagunda and Wollny, 2003). One of the most rapid ways of making genetic change is to introduce of the characteristics of a new breed by crossing it with the indigenous breed. For any one pair of genes, the two alleles present in a cell may be the same (homozygous) or different (heterozygous) (Gjedrem and Baranski, 2010). The two alleles are likely to different in the strength of their effect on the characteristic they are helping to control. It is a basic presumption of animal breeders that for at least a proportion of genes carried by breeds different breeds are likely to carry alleles (affecting the same trait) in different frequencies, possibly to be homozygous for different alleles (Purdom, 1992).

Crosses between different breeds are likely, therefore, to have a larger proportion of heterozygous gene combinations than the parental breeds the chance to lose an existing specific and unique gene combination within an indigenous population, therefore, increases through crossbreeding which are often introduced as improvement programmers indiscriminate crossbreeding and continuous substitution of indigenous breeds has been identified as one of the major threats to the conservation of indigenous breeds (Wollny, 2003).

Reproductive inefficiency: In the productive lifetime of any individual animal there is an expected number of progeny that that animal can produce. Productive lifetime being the period between first calving and culling is the effective period in as far as reproduction is concerned. His being the case productive life time is breed specific and at times production system specific and is mainly dependent on fertility or reproductive traits (Chagunda and Wollny, 2003). Traits like age at first calving, number of inseminations per conception, gestation period, calving interval, playa very vital role on determining the productive lifetime of any individual cow. In bulls, their general fertility and fecundity determines the number of progeny that the individual will leave in the population after being culled (Chagunda and Wollny, 2003; Clay, 2007).

Lack of breed societies: Breed societies are the keepers and developers of two valuable resources first, the breeds they represent and second, the people associated with them (Kubbinga *et al*., 2007) Breed society is a farmers organization whose "Board of Directors" are livestock farmers while management and operations are carried out by technical experts (Coleman, 1988). Traditionally breed societies are the pedigree houses where their main functions include maintenance and management, breeding stock, selection of breeding stock and organization of animal shows. Increasingly breed societies are being structured around the computer. Maintaining databases and analyzing them with modern techniques has become the order of the day (Anonymous, 2007). Breed societies are these days heavily involved in adding value to their breeds by making known the actual and perceived benefits of their particular breeds versus breeds. This is done through marketing and promotion, hence conservation by utilization (Kubbinga *et al*., 2007; Coleman, 1988).

Identification and categories of breed endangerment: The methodology to identifying breeds that is at risk, those breeds where conservation attention might be addressed (Anonymous, 2007). As a result of censuses, surveys and analysis, the risk status of the national breeds can be assessed. It is worth pointing out that breeds at risk may not all have a strong conservation value and that in some countries funds could be insufficient to conserve all breeds at risk. This aspect of determining the conservation value and prioritizing breeds for conservation (Noss *et al*., 1997).

Extinct: A breed is categorized as extinct if it is no longer possible to easily recreate the breed population. This situation becomes absolute when there are both no breeding males or stored semen no breeding females (oocytes) nor embryos remaining (Anonymous, 2007). The presence of sufficient cryopreserved material could allow for the reconstruction of a breed even if no live animals are available. For all practical purposes, extinction may be reached well before the loss of the last animal, gamete or embryo because a small number of living animals represents a very small amount of genetic information which is insufficient to keep the breed viable (Pimm *et al*., 1988).

Critical: A breed is categorized as critical if: the total number of breeding females mated to males of the same breed is <100 (<200 for Low-RC species) or the overall population is >100 (>200) for Low RC species) but the number is decreasing and expected to reach the size of 100 (200) for Low-RC species) females within 10 years or the total number of breeding males is = 5 (or ΔF is 3% or greater) (Anonymous, 2012).

Critical maintained: For breeds for which demographic characteristics assign a status of critical but that have active conservation programmers (including cryoconservation) in place or populations that are maintained by commercial companies or research institutions (Anonymous, 2007).

Endangered: A breed is categorized as endangered if: The total number of breeding females mated to males of the same breed is between 100 and 1000 (200 and 2000) for Low-RC species) or the overall population size is >1000 (>2000 for Low-RC species) but decreasing in size and expected to be between 100 and 1000 (200 and 2000 for Low-RC species) females within ten years or the total number of breeding males is between 5 and 15 (or the expected rate of inbreeding per generation is between 1 and 3%) (Anonymous, 2007; 2012; Seidel and Seidel, 1991).

Endangered maintained: Breeds that are endangered according to demographics can be considered endangered maintained if active conservation programmes are in place or populations are maintained by commercial companies or research institutions (Anonymous, 2007).

Vulnerable: A breed is categorized as vulnerable if:the total number of breeding females mated to purebred males is between 1000 and 2000 (2000 and 4000 for Low-RC species) or the overall population size is >2000 (>4000) for Low-RC species) but decreasing and expected to reach a size between 1000 and 2000 (2000 and 4000 for low-RC species) within ten years or the total number of breeding males is between 15 and 35 (or the expected rate of inbreeding per generation isbetween 0.5 and 1%) (Anonymous 2007; Seidel and Seidel, 1991).

Not-at-risk: A breed is categorized as not-at-risk if the population status is known and the breed does not fall inthe categories of critical or endangered (and the relative sub-categories) or vulnerable. In addition, a breed can be considered Not-at-risk even if the precise population size is not known but existing knowledge is sufficient to ensure that the population size exceeds the respective thresholds for the vulnerable category. Nevertheless, for such breeds the implementation of asurvey to obtain a more precise estimate of population size is strongly recommended (Anonymous, 2007; 2012).

Unknown: This category is self-explanatory and calls for urgent action. A population survey is needed, the breed could be critical, endangered or vulnerable (Anonymous, 2007).

Collections of animals genetics resources: Animals genetics resource is collected on farm or at collection facilities will depend on the conditions within country, the availability of resources and the accessibility of the targeted animal populations. Collection and processing procedures were differ widely depending upon the type of germplasm being collected and the donor species (Anonymous, 2012).

Semen collection: Semen is one of animal's genetics resources which can be collected by the following methods.

Collection with an artificial vagina: Different types and sizes of AV are available for use in different species and breeds within species (bull, ram, buck goat, stallion and buck rabbit). Before collection, the AV should be prepared

with a large-enough volume of warm water to ensure sufficient physical pressure to stimulate the glans penis of the male. The inner wall of the AV should be between 42 and 48°C, depending on the body temperature of the animal and should remain within the same temperature range throughout the semen collection process. The collection liner of the AV should then be lubricated with a non-spermicidal sterile gyna ecological lubricant (Watson, 1978).

The use of a teaser animal of the same species is recommended. The teaser animal facilitates collection by allowing the donor male to mount and ejaculate in a way similar to natural mating. A live teaser may also be used to increase arousal by allowing the donor to follow the teaser while it is led around the collection area immediately prior to collection (Watson, 1978).

Electro-ejaculation: In general, the AV method is preferred for semen collection as it tends to yield the highest quality semen and cause the least stress in the animal. However, in some situations where donor male cannot be traine for conventional collection such as atremotesites in the field, collection via. electro ejaculation is the most practical option (bull, ram, buckgoat, not stallions). Prior to the electro-ejaculation procedure, the collection tubes (or cones) will need to be prepared. In the case of bulls, the conical glass tubes need to be insulated using a 37°C water jacket. Ram- and buck-semen collection tubes can be handled similarly or simply kept insulated by the hand of the collecting technician (Anonymous, 2012).

Gloved hand collection techniques: For collection of pig semen, the boar is first allowed to mount a teaser animal or mounting dummy. The penis needs to be fully extended prior to semen collection. The protruding penis is then grasped, so that, the ridges of the penis are between the collector's fingers and pressur e can be applied to the glans penis with the smallest finger of the collector's hand. After the initial fractions of the semen are ejaculated, the sperm-rich portion (which has a milky appearance) should be collected into a 37°C insulated container covered with two layers of sterile gauze to remove the gel fraction (Colenbrander *et al*., 2000).

Abdominal stroking: In poultry, semen collection is performed by the abdominal massage method described by this procedure works best when done by two persons working together. One person carefully restrains the bird between his or her arms and body while the second person collects the semen. This person massages the abdomen of the bird with firm rapid strokes from behind the wings towards the tail. The animal's readiness to ejaculate is indicated by the tumescence (erection) of the phallus. At this point, the handler gently squeezes the cloaca with two or three fingers, expressing semen through the external papillae of the duct deferentis and into a pre-warmed tube held underneath the cloaca. The person collecting the semen must be careful because the close proximity of the penis and cloaca increases the likelihood of the semen being contaminated with faeces, urates and bacteria which have a detrimental effect on semen quality. Semen can be collected from mature males twice or three times per week. Either, a graduated glass funnel-shaped tube or a standard graduated glass tube can be used and the collection tubes should be placed in a 25°C incubator for processing (Burrows and Quinn, 1935).

Epididymal sperm collection: Over the years, attempts have been made to harvest epididymal sperm from live intact males (mammalian species) either by catheterization or by flushing the lumen of the cauda (tail) of the epididymis with a hypodermic needle and a plastic syringe. Of these two approaches, catheterization of the cauda epididymis in the mature male is reported to be the most successful. In most males, the catheterization procedure is successful but frequent post-surgical problems with the indwelling catheter have meant that this approach (Guerrero *et al*., 2008).

RESULTS AND DISCUSSION

Embryo collection: Production, collection, processing and freezing of embryos are more demanding than the equivalent procedures for semen and a greater level of training and experience are required. Livestock embryos are collected from donor females by flushing the reproductive tract using a physiological flushing mediu (Hasler, 2014). The most often-used flushing medium for cattle is Phosphate Buffered Saline (PBS) which can be obtained by mixing commercially available dry packets with water or purchased as a ready-prepared solution. Various other media are also commercially available. In some species (e.g., cattle, horses and buffaloes) harvesting donor embryos is most often done using a non-surgical standing method but in other species (e.g., pigs, sheep and goats) a surgical approach is usually required (Hasler, 2014).

Surgical embryo collection: Today, surgical embryo collections in pigs, sheep and goats are usually done at commercial ET units. Information on surgical procedures available for sheep and goats is provided in over the years, research reports have described various non-surgical approaches to embryo collection and transfer in these species. However, in most cases, the

number of embryos recovered per collection and the pregnancy rates per embryo transferred are lower than those achieved using the standard surgical approaches (Baril *et al*., 1993; Baldassarre and Karatzas, 2004).

Non-surgical embryo collection: Today, virtually all cattle embryos collected in the field and in-clinic by commercial ET companies are collected by a simple, non-invasive non-surgical procedure non-surgical embryo collection and transfer pose little risk to the cow and greatly reduce the time needed for harvesting embryos. The drawback of non-surgical embryo collection is that embryo recovery rates may be a little lower if collection is done by a less-experienced technician (Akingboye, 2012).

There are two basic approaches to non-surgical recovery of embryos from cattle Chapman. The body of the uterus and uterine horns can be flushed simultaneously using a single flushing procedure, often referred to as "uterine body flushing" or "body flushing". Alternatively, each uterine horn can be flushed separately using two flushing procedures, a process known as "uterine horn flushing " or " horn flushing". Flushing with either of these approaches usually recovers 50-90% of available ova/embryos, depending on the experience of the technician (Akingboye, 2012).

The potential number of embryos available for collection can be determined through palpation or ultra sonic examination based on the number of corpora lutea present on the ovaries of the donor animal. However, rectal palpation of donors with a large number of ovulations yields the imprecise estimate. It is therefore recommended that, if possible, ultrasonography be used to evaluate the ovaries of the donor prior to the embryo collection procedure (Seidel and Seidel, 1991).

Oocytes: Two approaches can be used for collection of oocytes. Conventional oocyte collection consists of harvesting oocytes from ovaries that have been removed from a donor female. Transvaginal Ultrasound-Guided oocyte collections (TUGA) on the other hand, consists of removing oocytes from the ovary of a living animal. The choice between the two approaches were depend on a number of factors including technical capacity, financial resources and the value of the donor female (Kwong, 2012).

Somatic cells: Collection of tissues other than germ cells and embryos can be useful for gene banking, either for the production of new animals (through SCNT) or to obtain genetic and health-related information about the animals sampled (DNA isolated from cells) (Anonymous, 2012).

Tissue: Somatic cells for subsequent use in DNA analyses or SCNT can be sampled from the tissue of live animals or from animals shortly after death because the requirements for the two objectives (DNA or SCNT) differ separate protocols have to be used for each. For DNA, one approach is to use a sterile scalpel blade to aseptically remove thin strips of skin from the body surface (e.g., shoulder area) of an animal and then place them in a pre-labelled sterile screw-top vial for transport to the processing laboratory. Tissue can also be easily obtained from the peripheral border of the ear of a live animal (or immediately after the animal's death) using a sterile hole punch (Baril *et al*., 1993).

Animals genetics resource conservation: Conservation is an action under take to ensure that the diversity of farm animal genetic material is being maintained for contribution to food production, agricultural production and productivity through planning, strategies and policies for future purposes. Effective conservation of genetic resources is possible only if the breeds are identified and documented adequately and there is a full participation towards conservation efforts of communities keeping the animals (Anonymous, 2012).

Methods for conservation: There are three methods for the conservation of animal genetic resources. The first involves the conservation of animal genetic material in the form of living ova, embryos or semen stored cryogenically in liquid nitrogen (-196° centigrade). The second is the preservation of genetic information as DNA, stored in frozen samples of blood or other animal tissue or as DNA Segments. The third is the conservation of live populations (Anonymous, 1999).

In-situ conservation: Refers to 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.

Ex-situ in vivo conservation: Refers to conservation through maintenance of live animal populations not kept under normal management conditions (zoological parks and in some cases governmental farms) and/or outside of the area in which they evolved or are now normally found. There is often no clear boundary between in situ and ex situ in vivo conservation and care must be taken to describe the conservation objectives and the nature of the conservation in each case (Anonymous, 2007).

Ex situ *In vitro* conservation: Refers to conservation external to the living animal in an artificial environment, under cryogenic conditions including, inter alia, the cry conservation of embryos, semen, oocytes, somatic cells or tissues having the potential to reconstitute live animals (including animals for gene introgression and synthetic breeds) at a later date (Anonymous, 2007).

Cryoconservation: Cryoconservation is the collection and deep-freezing of semen, ova, embryos or tissues for potential future use in breeding or regenerating animals. A key question with respect to cryoconservation is whether in the short term, the facilities and expertise required for collecting the samples can be financed and put in place. The logistics and costs of establishing and maintaining storage facilities will need to be addressed be fore the cryo conservation schemeis set up (Watson and Holt, 2011).

CONCLUSION

Indigenous farm animal genetic resources carry genes that enable them to tolerate harsh environments, cope with thorny vegetation in drought-prone areas, walk long distance and repel attacks by diseases and pests. However, these animal resources are constantly being eroded and are nearing extinction. Conservation of local breeds should be considered whenever the development of animal production.

Effective conservation of genetic resources is possible only if the breeds are identified and documented adequately and there is a full participation towards conservation efforts of communities keeping the animals.

RECOMMENDATIONS

The future breeding policy on development and conservation of farm animal genetic resources should include strategies and guidelines for farmers, researchers, extension workers and animal breeds that are suitable for the various agro-ecological zones it should also include alternative breeding programs, regulations of import and export of genetic materials, characterization , conservation and sustainable use of indigenous genetic resources and use of modern breeding technologies. Therefore, conservation of farm animal genetic resources are useful for the sustainable utilization of livestock and livestock products.

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