Principles for the Scientific Breeding of Nguni Cattle and Registration Eligibility of Stud Breeders

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Background

The traditional communities of Africa have been the custodians of the Nguni for many centuries and kept it in its pure state. This resulted in the different ecotypes that we currently find within the classification of the Nguni. For them, the Nguni fulfilled religious, ritual and subsistence purposes. To this day, the Nguni fulfils this purpose amongst tribes across Africa.

The genetic material that they conserved was not influenced by modern breeding programmes, artificial breed standards, or pressure for commercialisation. The sought after characteristics of the Nguni have been developed over centuries of tribal culling of animals, natural selection, and selective breeding for "survival of the fittest". As the Sanga (African) cattle migrated down Africa, from Egypt towards South Africa, different ecotypes of Nguni developed as tribes settled. Examples of these include the Nkone of Zimbabwe, the Mashona of Eastern Zimbabwe and Mozambique, and the Swazi of Swaziland to name a few. Each of these are classified as Ecotypes of the Nguni.

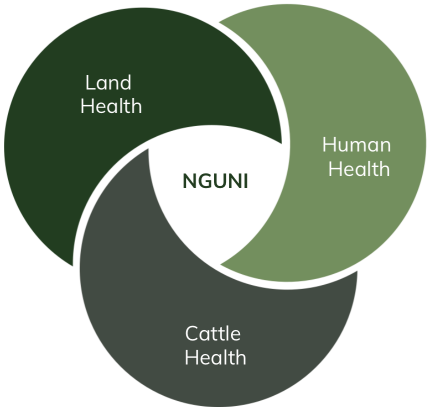
In modern day, Nguni genetics have spread across Africa and Internationally. This puts the concept of “keeping the Nguni in its pure state” under pressure, since it implies that no Nguni ecotype that is kept outside its original area of occurrence can be accepted as an Nguni from that ecotype, as its genetic fingerprint will change. Nguni Australia is acutely aware of this and understands that by breeding the Nguni internationally (outside of its original ecotypes), we have a responsibility and duty to ensure that the Nguni genotype is kept as closely mapped to the original Nguni genetic sequence. This is even more pertinent given the fact that Australia currently has the ability to export Nguni genetics to other parts of the world. Strict standards have to be put into place to ensure that we conserve the Nguni both within Australia and Internationally.

The Nguni’s genetic diversity across ecotypes makes it difficult to base breeding eligibility on genotype mapping. This is because each ecotype has been found to be genetically diverse when measured using micro satellite markers (Sanarana, et al., 2016). Furthermore, given Australia breeders hold cattle from the different ecotypes within the same herd, it is inevitable that eventually a hybrid of the differing ecotypes will come to be in Australia. It is also expected that the environment that the Nguni finds itself in will impact its genetic mapping over time through adaptation. The Nguni has proven to be highly adaptable to its differing environments, a unique and sought after characteristic for breeders and farmers, but a challenging characteristic when one wants to measure the different genotypes of the breed. It is expected that over time, Australian breeders will form new ecotypes of the Nguni depending on the region, climate, etc that the animal is raised in. It is because of this very reason that The Nguni Breeders Society of South Africa has created a breeding policy which requires certain phenotype characteristics, reproductive traits, and production traits to be met. It is these standards that ensure that the unique combination of characteristics of the Nguni are preserved.

These unique characteristics include a combination of:

- Early Maturing
- Fertile
- Disease, Parasite, and Tick Resistance
- Excellent Grass to Meat Conversion
- Excellent Mothering Ability

If these characteristics of the Nguni are preserved, the Nguni holds the key to farming livestock in a way that is regenerative for human health, land health, and cattle health.



General Objective

The purpose of creating registration eligibility requirements is to set guidelines for the scientific breeding of Nguni cattle. The first step is to set a breeding objective that will maintain certain acceptable properties and standards of the breed, while at the same time improve on those where individuals do not fulfil the requirements that are needed.

The Nguni breed is recognised as a sub tropical and tropical adapted cattle breed that can be sustainably utilised in any livestock farming system. Recent research by Makina et al. (2016) and previous information on the metacentric Y-chromosome of the Nguni that is common with the of Bos Taurus, confirms that there is very little evidence of Bos Indicus in the modern day Nguni and they can therefore be described as taurine tropical adapted breeds, which makes them fairly unique. It is hypothesised that due to the zebu's susceptibility to trypanosomiasis, that their genetic introgression has become limited or removed altogether, especially in eastern to western Africa where tsetse infestation is rife. The Nguni should therefore be classified as an adapted taurine breed type and not an indicine (Zebu) breed type. More specifically, new science, that follows the mapping of the Bovine genome and identification of the genetic isolation, shows that Sanga cattle originating in Sub-Saharan Africa disconnected from Bos Indicus and Bos Taurus cattle for over 2000 years ago and should therefore, more accurately, be classified as Bos Africanus.(Makina, 2016).

Nguni Australia has an overall objective of **conservation** of the breed. Specifically, we aim to conserve, regenerate, and enhance the phenotype and functional efficiency of the Nguni. Our aim is to only register Nguni animals that present the very best in Nguni genetics, phenotype, fertility and functionality. This will ensure optimal beef production from the natural vegetation whilst maintaining and developing the unique reproduction and production traits of the Nguni breed. Additionally, this objective will ensure that the Nguni is preserved for multiple generations to come. Furthermore, Nguni Australia is the official breed representative and patron of Nguni in Australia under **The Australian Registered Cattle Breeders Association (ARCBA)**. This places on to it, the responsibility to conserve, protect,

and sustain (amongst others) the genetic integrity of Nguni Genetics that are both imported and exported to and from Australia.

Overall, the purity of indigenous African cattle breeds is under threat due to cross-breeding. Pure Nguni cattle numbers in South Africa for example, declined from1,800,000 in 1992 to 9462 in 2003. Here in Australia, the Nguni is considered at risk with 2022 statistics reporting around 350 head. African cattle breeds are in danger of extinction, 22% of African cattle breeds have already become extinct over the last century. Extensive cross-breeding, replacement with non indigenous African breeds, and social/environmental disasters have placed the Nguni at risk and it is up to modern day breeders to ensure that their unique genetic makeup is not lost completely.

With this in mind, Nguni Australia has strict guidelines about what animals they will register under their certification. We have based these requirements on scientific evidence, conservation guidelines, and genomic sequencing of the Nguni. Furthermore, we have used the registration guidelines set out by The South Africa Nguni Cattle Breeders Society. Once an Nguni's pedigree is verified by Nguni Australia and registration eligibility is met, other breeders both domestically within Australia and Internationally can be assured that the registered Nguni in question is of high full blood standard. It is Nguni Australia's vision that once these genetically superior animals are identified in the population, their widespread use as breeding stock will ensure rapid achievement of Nguni conservation and longevity of the breed. For those full blood Nguni that do not fully meet the criteria for Stud Nguni registration, but can prove their full blood genetic lineage, Nguni Australia will work along side the breeder to support them in either getting the animal or progeny of the animal to meet the criteria in the future by either making changes in husbandry, improvements in health, or improving genetics through superior sire breeding. Together, we can insure that the Nguni in Australia not only survives, but thrives.

Guidelines for Registration

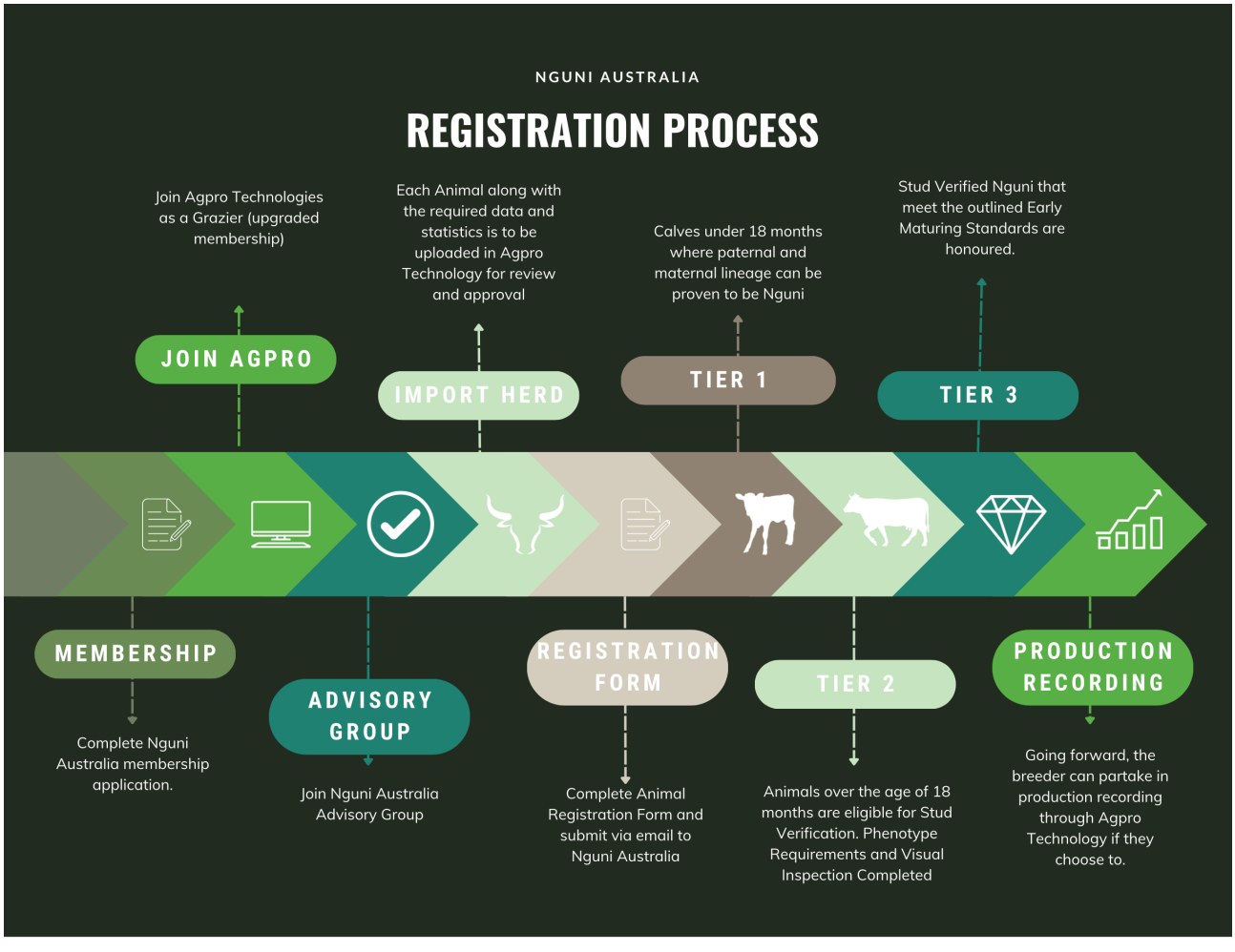
1. Complete Nguni Australia membership application.
2. Join Agpro Technologies as a Grazier (upgraded membership)
3. Join Nguni Australia Advisory Group
4. Each Animal along with the required data and statistics is to be uploaded in Agpro Technology for review and approval
5. Complete Animal Registration Form and submit via email to Nguni Australia
6. There are three levels of verification and certification available to member.
    a. **Tier One:** Calves under 18 months where paternal and maternal lineage can be proven to be Nguni, will be verified as full blood Nguni. Registration costs are free. Once verified, the breeder will receive a certificate outlining the animals pedigree.
    b. **Tier Two:** Animals over the age of 18 months are eligible for Stud Verification. To meet Nguni Stud Certification, the animal in question must meet the Phenotypic Requirements outlined below. Additionally, the animal must pass a visual inspection carried out by one of Nguni Australia's registered Inspectors. If the animal meets these strict guidelines then it will be classified as Nguni Stud, included in the Nguni Stud book and will be promoted as excellent breeding stock, both domestically and internationally. Verified Stud Nguni will be given a Stud Certificate which includes a

livestock report. Additionally, Stud Nguni will receive a Branded Metal Livestock Identification Tag. This ear tag is only available to Stud registered Nguni. Registration costs $10-00 (including gst) per head for Stud verification. Additionally, travel for visual inspection is at the breeders expense. Nguni Australia will work with the breeder to make travel expenses as affordable as possible.

c. **Tier Three:** Those Stud Verified Nguni that meet Early Maturing Standards are eligible for Nguni Australia's most prestigious verification. Registration Requirements for this prestigious certification are in review.

7. Going forward, the breeder can partake in production recording through Agpro Technology if they choose to. We recommend keeping record of Fertility Statistics, Behavioural Statistics, and Growth Statistics.

Note: The data base will be reviewed once per annum by cancelling all animals that don't meet standards for Stud Registration.



Registration Requirements (Tier One)

Nguni Ecotypes Recognised

Based on The Nguni Breed of Cattle, Past, Present, and Future (scholtz, Gertenbach, & Hallowell, 2011), the following ecotypes are recognised as Nguni cattle: Swazi, Pedi, Shangaan, Venda, Zulu, Kaokoland, Ovambo, Kavango, Caprivi, Mashona, Nkone, Tswana, Barotse, and Landim. Nguni Australia will consider applications from any animal falling within these ecotypes.

Paternal and Maternal Genetics

To be eligible for registration, the animal must have both paternal and maternal full blood Nguni lineage. The lineage must be able to be traced back to an original Nguni embryo imported from Africa. Genetic testing proving such lineage must be presented when applying for registration.

Registration Requirements (Tier Two)

In addition to Tier One requirements, Stud Nguni need to meet the following:

Phenotypic Requirements

Due to the variation in genomic mapping across ecotypes of the Nguni, phenotypic and visual requirements are necessary to ensure that the unique traits of the Nguni are preserved. That is, specific observable characteristics must be recorded and a visual appraisal must be met. As part of its team, Nguni Australia has one of two Australian visual inspectors that are registered by the Nguni Breeders Society of South Africa. This means, our team have decades of experience breeding Nguni and are well versed in knowing what phenotypical characteristics are important to preserve the breed.

Phenotypic Requirements are as follows:

- Reproduction:
  - Must calve within 39 months of age.
  - Minimum acceptable gestation period is 266 days and the maximum period is 308 days.
  - Any dam should, under generally acceptable production conditions, successfully raise and wean (weaning age of at least 5 months) three out of any four consecutive calves.
  - No inter calving period should exceed 730 days.
- Bulls
  - Breeding Soundness Evaluation (BSE) must show at least >40% sperm motility, 70% normal sperm morphology, and a minimum scrotal circumference based on age (Table 1). An updated BSE is required before straws are milked for IVF, AI, and Export purposes. It is recommended that Bulls undergo a BSE yearly.

Table 1: Minimum Scrotal Circumference in comparison to age

150-199 kg	26cm
200-249 kg	27cm
250-299 kg	28cm
300-349 kg	29cm
350-399 kg	30cm
400-449kg	31cm
450-499kg	32cm
500 or more kg	33cm

- Mothering Ability
  - No cow should be allowed to produce a registered bull if she needs any assistance when calving where the sire of the foetus is an Nguni.
  - Cows with fusion of the teats, which is determined by an autosomal recessive gene, is discriminated against.
  - Bottle teats are highly heritable and are discriminated against.
- Growth and Efficiency
  - Dam (Female)
    - No minimum (or maximum) growth criteria should apply for females.
  - Sire (Male)
    - Males should be discriminated against if at any stage of his dam's life, before or with his birth), she did not conform to the minimum reproduction or maternal requirements for females.
    - Any Nguni Bull with the following physical attributes should be castrated
      - Uni or bilateral testicular hypoplasia (significantly smaller testes and is caused by chromosomal abnormality)
      - Cryptorchidism: a condition in which one or both testes fail to descend from the abdomen into the scrotum.
      - Y-shaped or fleshy sheath
      - Excessive sheath opening (preputial orifice) and any physical signs of prolapse of the prepuce.
      - Underdeveloped epididymis
- Genetic Deficits Discriminated against
  - Albinism: the animal as a whole, may be an albino, or there may be albino spots on the body. This should not be confused with other than black pigmentation such as brown or amber. Lack of proper skin pigmentation, especially the ears, eyes, anus area, udders, and scrotum. Albinism is more detrimental in breeding bulls compared to cows, as the genetic defect can spread more readily.

    - Wry tail – the tail is twisted to one side at the tail head. These animals should be culled, as the next stage is an open spinal cord which is lethal.
    - Laminitis – outgrow of hooves. This is highly heritable and is determined by a single recessive gene with incomplete penetrance and can therefore be removed by selection. Trimming the hooves is a short term solution – selecting favourable genotypes is advisable and lasting.
- Other discriminations held against bulls used for breeding
    - Lack of proper skin pigmentation especially the ears, eyes, anus area, and scrotum.
    - Wild temperament
    - Woolly coat in summer
    - excessive tick infestations compared to contemporaries
    - flat rump
    - straight hocks
    - skew face
    - under or over shot jaw
    - low libido
    - fat deposits in the neck of the scrotum
    - excessive scrotal twist
    - a long fleshy sheath

Visual Requirements as Follows:

Inspections are very important, but have to be objective and have to take into account the ecological region wherein the inspection is carried out since this can influence phenotypic characteristics. Inspectors will never enforce their preference for a specific type of Nguni on the rest of the breed. Cattle inspected should first be judged upon phenotype and functional efficiency as these are key to functional Nguni farming in the long term. Considerations other than the former must weigh less in judging an animal as the gene pool of the Nguni breed can by limited and damaged by too tight inspections rules that will neglect the Nguni's historical origins and its conservations. Therefore, The accent of visual inspections is on functional efficiency of the animal. Animals with hereditary defects or with deviations, which will impede the functional efficiency according to the inspector, will be rejected.

- Size and Mass
    - Bulls are of medium size weighing 500-800 kg. The average shoulder height of bulls (± 15 months) is ± 120 cm. Cows are smallish and weigh 300 kg to 480 kg. Their body length is ± 130 cm and height at shoulder ± 119 cm.
- Shape and Proportions
    - Nguni cattle should have a functionally efficient conformation. They are of the respiratory type and exhibit harmonious proportions giving a neat appearance.
- Head
    - The head is of medium size and length with lean fleshing and an alert appearance. The shape is not coffin shaped. The jaws are deep. The profile is longitudinally straight but slightly dished laterally. The forehead is usually at least as long as the face and widest at the eyes' orbital prominence. The eyes are well-spaced, alert and the brows are not heavy or prominent. There should be good pigmentation around the eyes. Their apparent size varies between sexes, being prominent in females but not protruding in males. The face is wide, decreasing only slightly to the muzzle. Its profile is straight.

    - The nose is straight, strong and well-defined. The muzzle is broad, strong and dark-pigmented. The lower jaw is well-formed, but not too prominent or over/undershot.
    - Ears are small, pointed and covered with short, dark-coloured fine hair and no fringe. Their position is below and behind the horns. Nguni's are predominantly horned, but occasionally naturally polled animals occur. The poll width depends on the presence and placement of the horns being wider and rounder in bulls and animals with wide or no horns.
- Neck and Dewlap
    - The neck is moderately long and well-attached to head and forequarters being lean in cows but shorter and fuller in bulls. This commences as a single fold between the lower jaw, tucked up below the throat and terminating between the forelegs.
- Hump
    - The hump is situated cervico-thoracically and is muscular in structure. The size and shape of the hump is reasonably well-developed in bulls especially after 3 years but in females is only evident in individual animals in good condition.
- Forequarters
    - The withers are comparatively narrow and well-defined in females – heavier in males. The shoulder is short and relatively upright. The barrel of the chest is of the respiratory type with well sprung ribs. The brisket is only slightly prominent. The forearm is of moderate length, lightly muscled and fine-boned. The knee is small and round with dense bone. Cannons are moderate in length, fetlocks small and pasterns are short. All have fine, dense bone. Pasterns are short and slightly sloped to the upright. Feet are high heeled, round shaped and hooves have dark dense colour and are close together in front but can be more open medially. Front feet are larger than hind feet. Claws articulate separately and more freely.
- Middle Piece
    - The back is straight, strong and well-muscled in the loin of bulls, but the top line tends to be slightly hollow. The abdomen has adequate capacity and is well carried. The hind flank has fair depth and fullness, and the navel flap is small.
- Hindquarters
    - The rump is not very broad in hookbone, thurl and pinbone, but moderately long, dropping from hook to pinbones. This together with a prominent sacrum gives a slightly roofy tendency to the rump. The tail is long and thin with a flexible tip. It has no long hair on it but has a full brush (switch) and extends down to the hocks. The thighs are round and relatively lean, and the twist is not very deep. The shank (gaskin) is long and lean. The hocks are of excellent depth with good placement but tend to be sickle and cow hocked. The bone of the hind legs is small and dense. The cannons, fetlocks, pasterns and feet are of similar quality to that of the forelegs.
- Hide and Hair
    - The Nguni has a well-pigmented, motile hide of medium thickness and the coat is short, fine and glossy (oily). The coat colour patterns are legion and warrant a separate descriptive catalogue but black, red, dun, roan, speckled and patched animals are acceptable. Pure white bulls which are unpigmented are discriminated against.
- Male Organ
    - Testes are of functional size and shape, equal in size and not hypoplastic. The scrotum is pigmented with well-developed thermoregulatory function. The sheath is small and not pendulous.

- Milk System
  - The udder is moderate in size, but well-developed. It is well attached and- carried and does not droop. Teats are smallish but well-pigmented and functional. Milk veins are not prominent.
- Temperament
  - The Nguni is docile but alert and has good mothering ability.

Registration Requirements (Tier Three)

We are in discussions with geneticists from South Africa and the United States, Nguni Breeders Society of South Africa, and reviewing the Scientific Research to determine the indexes that need to be met for an animal to receive Tier Three registration. This will be Nguni Australia's most prestigious certification.