On-farm characterization and present status of North Bengal Grey (NBG) cattle in Bangladesh

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Summary

North Bengal Grey (NBG) cattle are an important indigenous cattle genetic resource found mainly in the northern part of Bangladesh. The study was undertaken at Bogra Sadar, Shibgonj and Kahalu Upazila (sub-district) in the Bogra district. The physical and morphological characteristics, and the productive and reproductive performances of NBG cattle were studied. The coat colour of these animals is deep grey to white. The coat colour of the neck region in adult bulls was found to be generally ashy with a range of shades.

The body is small, compact and less fleshy. Ear length and ear width were 18.0±0.17 and 11.0±0.21 cm, respectively. The head length average was 38.0±0.56 cm, the head width 16.0±0.17 cm, the foreleg length average 65.0±0.64 cm, the hind leg length 71.0±0.64 cm, the tail length average 71.0±0.67 cm, the horn length average 9.0±0.39 cm, the horn diameter 10.0±0.37 cm, the average teat length 5.0±0.18 cm, the teat diameter 6.0±0.22 cm, the distance between the front teats 7.0±0.13 cm and the distance between the rear teats 7.0±0.13 cm. Body length, height at wither and heart girth in adult cows were 105.0±1.20, 94.0±1.12 and 127.0±1.52 cm, respectively.

The recorded highest peak milk production per day was 3.5±0.18 kg, lactation length was 219±6.1 days, and the dry period was 180±6.8 days. The average birth weight of calves was 18.4±0.52 kg and mature live weight of cows 241.0±4.0 kg. The age at first heat was 869±29.6 days, age at first calving 1191±19.7 days, gestation length 281±1.3 days, calving interval 442±7.4 days, postpartum heat period 110±4.2 days and the number of services per conception 1.4±0.6. About 54% of total cattle population was NBG cattle in the surveyed area of Bangladesh. The results indicated that the productive and reproductive performance of NBG cattle was better than other non-descript indigenous cattle of Bangladesh. The study further revealed an obvious need for more in-depth and objective information on wider samples of this type of indigenous cattle in order to assess the future need for conservation and improvement programs to be undertaken.

Resumen

La raza bovina North Bengal Grey (NBG) es una raza indígena de importante recurso genético que se encuentra en la zona norte de Bangladesh. El estudio se inició en Bogra Sadar, Shibgonj y Kahalu Upazila (Sub-distrito) en la región de Bogra. Se estudiaron las características físicas y morfológicas y los rendimientos productivos y reproductivos de la NBG. El color del manto de estos animales va del gris oscuro al blanco. El color en la zona del cuello en los machos adultos suelen presentar variaciones de gris.

Es un animal de cuerpo pequeño, compacto y poco carnoso. El tamaño de las orejas y circunferencia es de 18,0±0,17 y 11,0±0,21 cm, respectivamente. La medida de la cabeza es de una media de 38,0±0,56 cm, la circunferencia de 16,0±0,17 cm, la largura de las patas delanteras de 65,0±0,64 cm, la parte trasera 71,0±0,64 cm, la cola tiene una longitud de 71,0±0,67 cm, los cuernos 9,0±0,39 cm, diámetro de los cuernos 10,0±0,37 cm, las tetillas 5,0±0,18 cm, circunferencia de las tetillas 6,0±0,22 cm, distancia entre tetillas 7,0±0,13 cm, y distancia entre tetillas traseras 7,0±0,13 cm. La longitud corporal, altura a la cruz y circunferencia torácica en los adultos fue de 105,0±1,20; 94,0±1,12; y 127,0±1,52 cm, respectivamente.

El pico máximo de producción de leche por día fue de 3,5±0,18 kg, la duración de la lactación fue de 210±6,1 días, y el período seco fue de 180±6,8 días. La media de peso al nacimiento fue de 18,4±0,52 kg y el peso a la edad madura de las vacas de

241,0±4,0 kg. La edad al primer celo fue de 869±29,6 días, edad al primer parto 1.191±19,7 días, duración de la gestación 281,0±1,3 días, intervalo entre partos 442,0±7,4 días, periodo de celo post-parto 110,0±4,2 días y número de servicios por concepción 1,4±0,5. Alrededor del 54% del total de la población de NBG en el cuestionario provenía de la zona de Bengladesh. El estudio reveló posteriormente la necesidad obvia de una mayor información sobre amplias muestras de este tipo de raza indígena para poder establecer un programa futuro de conservación y mejora de la raza.

Keywords: *Genetic resource, Physical characteristics, North Bengal Grey cattle, Production, Reproduction, Measurements.*

Introduction

Bangladesh is an agricultural country. Livestock, being one of the major components of agricultural output (crops, livestock, fisheries and forestry) plays a vital role in national economy, contributing about 6.5% of Gross Domestic Product (GDP) and 13% of total foreign exchange earning (DLS, 1994). The total ruminant livestock population of Bangladesh is composed of 24.0 million cattle, 34.4 million goats, 0.83 million buffalos and 1.14 million sheep (FAO, 2002).

Bangladesh has high density cattle population. The relative density of the cattle population is well above the averages found in many other countries of the world. It ranks 12th in cattle populations in the world, and third among Asian countries (Alam *et al*., 1994). Despite such a highly dense cattle population, the country has been deficient in milk, meat and draught power for quite some time. The cattle resources of Bangladesh are mostly of the indigenous type (*Bos indicus*) with a substantial number of Sindhi, Sahiwal, Jersey and Holstein-Friesian crossbreeds. Indigenous cattle experience late maturity, short lactation length, long calving interval and poor production of milk and draught power but are more disease resistant and capable of thriving in harsh conditions (Majid *et al*., 1992).

In the developing world, the indiscriminate use of exotic animal genetic resources and poorly designed breeding schemes are the major reasons for the loss of animal genetic resources. The loss of locally adapted breeds will have long term negative implications, and in most instances, will reduce food security rather than ensure it. Cattle are an inseparable and integrated part of the agricultural operation. There are a few improved varieties of cattle such as Red Chittagong (RC), Pabna Milking Cow (PMC) and North Bengal Grey (NBG) localized in some areas of the country. These so called 'varieties' of cattle have neither been identified (either by phenotypic and genetic characterization) nor has any objective study been made on their conformation or productive and reproductive performance with larger sample sizes *in-situ*.

The North Bengal Grey (NBG) cattle may be one such promising variety of domestic animal genetic resource. The history of the development of this variety is not clear. The productive and reproductive performance of NBG cattle has not yet been well evaluated. The documented scientific information on various traits of these cattle is at present lacking, therefore the present study was undertaken to evaluate and characterize the North Bengal Grey (NBG) cattle of Bangladesh with the following objectives:

1. To study the probable distribution pattern of North Bengal Grey (NBG) cattle.
2. To morphologically characterize the North Bengal Grey (NBG) cattle.
3. To assess their productive and reproductive performances.

Location and Temperature

The study area is located between 24º 30´ and 25º 10´ latitude, and between 89º 00´ and 89º 40´ longitude. The mean annual temperature is about 26 º C. Mean monthly temperature ranges between about 18 ºC in January and 30 ºC in April-May. Extreme temperatures range between about 4 ºC and 43 ºC, except on the coast. Ground frost is occasionally experienced in exposed parts of the hill areas but not on the plains.

Materials and Methods

The three Upazilas (sub-districts) namely Bogra Sadar, Shibgonj and Kahalu under Bogra district were selected as the study area. These three selected Upazilas are situated on the Northern side of the Bogra district in Bangladesh. These areas were also chosen for the reason that most of the NBG cattle are found in that area, therefore the area was considered suitable to conduct field survey. The questionnaire was carefully designed keeping the purposes of the study in mind. The questionnaire contained both open and closed form questions.

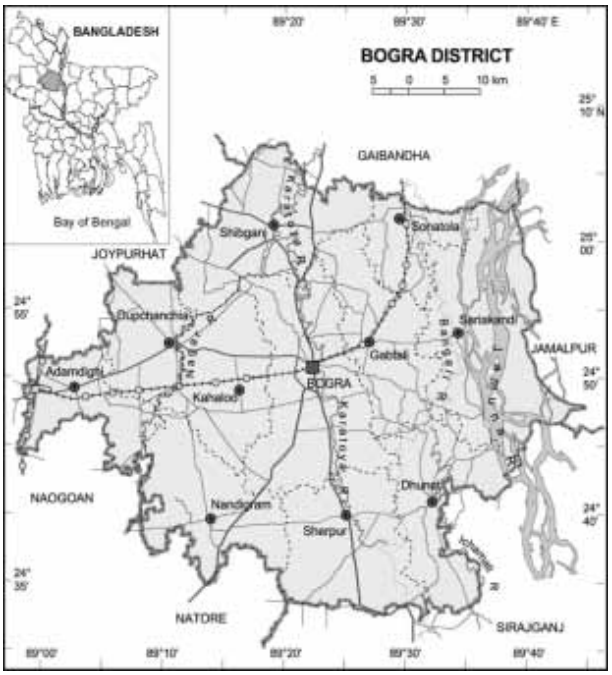

Figure 1. Geographic location of Bogra District in Bangladesh

Most easy, simple and direct questions were used to obtain information from the respondent farmers.

The questionnaire was pre-tested in order to judge its suitability for the respondents then finalized, necessary modifications having been made. Simple and direct questions were included in the questionnaire for the purposes of collecting information relating to the farmers such as age, education, occupation, family size, farm size, and for information relating to the cattle such as feeding management, production potential, reproductive characteristics, disease incidence, control measures and management of North Bengal Grey cattle. In this study, a total number of 100 animals were selected from three Upazilas, 40 from Shibgonj, 30 from Bogra Sadar and 30 from Kahalu. Animals were selected randomly as milking cows, dry cows, heifers, bulls, bullocks and calves

In order to collect relevant information an interview technique was used focusing on issues such as the farmers' socio-economic status, livestock population and genetic status, feeding regime, production potential, reproductive performance, physical characteristics, morphometric characteristics, disease control and management. In general, most farmers are not used to keeping any written information (records) on their livestock, so the researchers had to depend on the memory of the respondent for obtaining information. The information gathered in relation to the farmer himself was age, education, family size, occupation, and farm size. The livestock population referred to the total number of livestock, mainly cattle, reared by the farmer such as numbers of milking cows, pregnant cows, bulls, heifers, bullocks and calves of either sex. The genetic status of the livestock was determined on the basis of information provided by the farmers. The genetic status was mainly that of indigenous cattle, NBG Cattle and crossbred cattle.

Birth weights were taken directly with a balance. Adult body weight measurements were taken indirectly using Shaffer's method with the help of a measuring tape, i.e., body weight in kg = (L × G2 × 2.2)/300, where L is length (inch) from shoulder point to buttock and G is heart girth (inch).

Results and Discussion

Origin and distribution of NBG

The distribution of the target NBG cattle is presented in table 1. The graphical representation of NBG cattle is given in figure 1. Most of the interviewed farmers responded that the NBG cattle variety originated from the crossbreeding of local cattle with those imported from Bihar and Uttar Pradesh in India, in pre-independence days over a long period of time. This variety of cattle has good market value as a cart bullock in the Northern parts of the country and elsewhere (Nasim, 1965). The NBG cattle are available in the Northern regions of Bangladesh and although they are very rare in other regions, due to migration or trading it is not unusual to see NBG elsewhere in the country.

Feeding and management

The feeding and management system of NBG cattle in Bogra Sadar, Shibgonj and Kahalu area remained almost unchanged throughout the year. Stall feeding was mainly practiced although grazing was sometimes practiced, for example after harvesting crops in the field. Cattle mainly lived on rice straw and green grass. Most of the animals were not provided with any concentrate feeds.

Table 1. Distribution of NBG cattle in Bogra Sadar, Shibgonj and Kahalu Upazila of Bogra district in Interviewed Farmers.

Category	NBG (%)	Local (%)	Crossbred (%)
Milking cows	29.0	24.0	3.0
Pregnant cows	23.0	16.0	2.0
Bulls (Breeding)	22.0	24.0	2.0
Bulls (not used in breeding)	4.0	9.0	-
Heifers	29.0	9.0	4.0
Bullocks	4.5	4.0	1.0
Calves (Male)	9.0	8.0	-
Calves (Female)	8.0	4.0	1.0
Overall	54.0	41.0	5

Morphometric characteristics

Morphometric measurements (body length, height at wither and heart girth) were taken from 100 NBG cattle of different categories and are given in table 2. In all categories of the animals, heart girth was highest followed by height at wither and body length giving the appearance of a small, compact body. Males had greater body measurements when compared to females. Habib *et al.*, (2003) observed that the body length, body height and heart girth of adult Red Chittagon females were 114.38±1.56 cm, 107.71±0.93 cm and 139.85±1.63 cm respectively. For adult male the same measurements were 134, 125 and 168 cm, respectively. The mean morphometric measurements are presented in table 3.

Physical characteristics

The coat colour of NBG cattle was mostly deep grey to white with differing shades. The neck regions of adult bulls were an ashy shade, which is prominent and increases with age. The head was small and the colour of the muzzles, eyelids and hooves was black. Figures 2 to 5 show the distinct features of NBG cattle. Skin colour was predominantly black but in some of the animals was brown. The tail

Figure 2. A North Bengal Grey bull.

Figure 3. A North Bengal Grey bull.

switch was white in all animals. The horns were small to medium and curved inward with pointed tips (Figure 2 and Figure 3). The ears were small and erect with a sideways orientation and had pointed tips. The face was small and narrow with a flat forehead. The body was small, compact and less fleshy. The skin was tight, the dewlap was medium and the hump was small in females and developed in males (Figure 4 and Figure 5). The tail was long and reached to below the hock. Cows had small udders, teats and milk veins. The animals of this breed were usually quiet but adult males were of aggressive temperament. Figure 6 shows a NBG calf.

Production traits

Birth weight

Information on the birth weights of NBG cattle was gathered from 20 calves (Table 4). Habib *et al*. (2003) reported that the birth weight of RC calves was 17.24±0.68 kg in male and 16.0±0.66 kg in female

Table 2. Body measurements of NBG cattle.

Traits	Category	Number	Minimum	Maximum	Mean	S.D.
Height at wither (cm)	Cow	49	79	110	94	7.9
	Heifer	29	58	102	84	7.9
	Bull	17	67	105	93	9.7
	Overall	100	50	110	91	10.4
Body length at shoulder (cm)	Cow	49	67	120	105	8.5
	Heifer	29	61	115	88	13.9
	Bull	17	61	120	100	14.3
	Overall	100	61	120	99	13.8
Heart girth (cm)	Cow	49	103	154	127	10.7
	Heifer	29	73	145	101	16.2
	Bull	17	69	156	122	19.3
	Overall	100	69	156	117.8	18.5

Figure 4. A North Bengal Grey cattle with calf.

Table 3. Morphometric measurements of NBG cattle.

Characteristics	Number	Minimum	Maximum	Mean	S.D.
Ear length (cm)	100	13	22	18	1.7
Ear width (cm)	100	8	20	11	2.1
Head length (cm)	100	23	50	38	5.7
Head width (cm)	100	11	20	16	1.8
Fore leg length (cm)	100	46	78	65	6.5
Hind leg length (cm)	100	54	88	71	6.4
Tail length (cm)	100	43	90	71	6.7
Horn length (cm)	57	3	16	9	3.9
Horn diameter (cm)	57	4	16	10	2.8
Teat length (cm)	53	3	10	5	1.3
Teat diameter (cm)	53	3	10	6	1.7
Distance between fore teats (cm)	53	5	10	7	1.0
Distance between rear teats (cm)	53	5	10	7	1.0

with an average of 16.7±0.48 kg, which was lower than the results from NBG calves in the present study. Khan *et al*. (2000) observed the birth weight of RC calves in farm and rural condition to be 17.3±0.76 and 16.0±1.52 kg respectively which was very similar to the findings of Habib *et al*. (2003).

Body weight of mature cattle

The average body weight of mature NBG cows is shown in table 4. The mature live weight data was collected from 40 NBG cows. Khan *et al*. (2000) found the mature body weight of RC cows under farm and rural conditions to be 234.28 kg and 206.50 kg respectively, which is very similar to the results obtained in the present study.

Peak milk yield

The average peak milk yield observed in 29 NBG cows is presented in table 4. This estimate came from a sample of NBG cows at various stages of lactation, and should therefore fairly represent the daily milk yield in the NBG cow. Habib *et al*.

Table 4. Production performance of NBG cattle.

Characteristic	Number	Minimum	Maximum	Mean	S.D.
Birth weight (kg)	20	15	24	18.4	2.35
Mature body weight of cow (kg)	40	206	307	241.0	13.1
Peak milk yield (kg)	29	1	8	3.5	1.2
Lactation length (days)	39	150	365	219.0	38.2
Dry period (days)	39	60	240	180.0	42.4

Table 5. Reproductive performance of NBG cattle.

Traits	Number	Minimum	Maximum	Mean	S.D.
Age at first heat (days)	36	710	1460	869	177.3
Age at first calving (days)	36	1090	1460	1191	118.1
Gestation length (days)	36	269	300	281	7.9
Calving interval (days)	36	365	520	442	44.5
Postpartum heat period (days)	36	60	180	110	14.9
Services per conception	44	1	3	1.4	0.6

Figure 5. A North Bengal Grey cattle.

(2003) found the milk yield/d of RCC to be 2.55±0.11 litres. Khan *et al*. (2000) observed an average daily milk yield under farm and rural conditions to be 2.0±0.65 kg and 1.80±0.87 kg respectively which is lower than the results in the present study. Bhuiyan and Faruque (1993) analyzed the daily milk yield of 340 local cows and found it to be 1.63±0.72 kg which is also lower than that of the present findings. In another experiment Bhuiyan *et al*. (1992) found the average daily milk yield of local cows to be 3.00 kg. Jabbar and Ali (1988) found the milk production of local cows averaged 2.42±0.40 kg. From available studies a wide variation in milk yields in indigenous cows has been noticed and hints at an opportunity for selection among indigenous cattle resources in

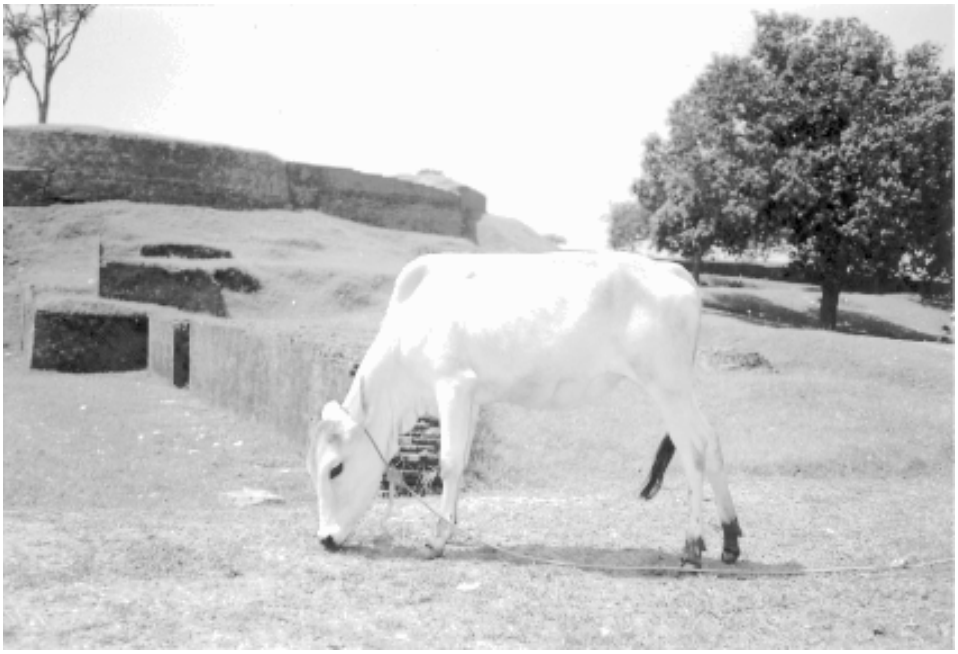

Figure 6. A North Bengal Grey calf.

order to increase milk yield in Bangladesh. Differences in genetic architecture, feeding systems, quality and quantity of rations, milker and time of milking may be affecting the daily milk yield of indigenous cows.

Lactation length (LL)

The mean lactation length (LL) along with SD of NBG cows is presented in table 4. Habib *et al*. (2003) reported a mean LL in RC cows of 261.08±14.51 days. Khan *et al*. (2002) studied the LL of RC cows and found it to be 222.85±16.03 days under farm conditions and 214.7±21.68 days under rural conditions. These results are close to that of the present study on NBG cows. Ahmed and Islam (1987) summarized the performance of local cattle for LL and found an average of 270 days, which is a little higher than the results of present study. Hoque *et al*. (1999) and Khan and Khatun (1998) studied the performance of PMC and found that LL ranged from 198.9±11.52 to 208.75±18.15 days which partially agrees with the findings of the present study.

Reproductive traits

Age at first heat

The mean age at first heat (AFH) along with SD for NBG cattle is presented in table 5. Rahman *et al*. (1987) investigated the AFH of local cows and found it to be 1283.19±41.93 days which is higher than the result of present study. Ashraf (1998) concluded that AFH of indigenous cows was 31.0±3.29 months. Ali (1994) showed that the AFH of local cattle was 42.40 months, which is higher than the result of present study. Fluctuations in age at puberty of various genetic groups of cows might be due to the effect of environment, varied management practices and heredity.

Age at first calving (AFC)

The mean age at first calving (AFC) along with SD for the NBG cattle is presented in table 5. Jabbar and Green (1983) reported the AFC of local cows to be 3.82, 3.85 and 5.45 years for non-draught, draught-1 and draught-2 cattle respectively, which is close to those in present study. Ghose *et al*. (1977) found that AFC was 1246.08±121.66 days for RC cattle. This result is very close to the results of the present study. Genetic and management factors especially feeding systems and methods of care might have influenced this trait.

Number of services per conception

The mean number of services required per conception (SPC) along with SD for the NBG cattle is presented in table 5. SPC information was

available on 36 cows only. Khan *et al*. (1999) studied the performance of RCC and PMC cattle and reported that SPC were 1.61±0.09 and 1.57±0.07, respectively. Habib *et al*. (2003) observed the average number of services required per conception for the RCC was 1.25±0.12.

Gestation length (GL)

The mean gestation length along with SD of NBG cows is presented in table 5. The overall gestation length for NBG cows was 281±1.3 days. Ahmed and Islam (1987) and Majid *et al*. (1999) found the GL of RCC cows to be 281.30±1.43 and 281.0±2.94 days, respectively – results which are very close to the results in the present study. Hossain and Routledge (1982), Khan and Khatun (1998) and Khan *et al*. (1999) reported the GL of PMC were 281.0, 283.61±8.23 and 279.10±1.04 days, respectively. These results are much closer to the values observed in the present study.

Calving interval (CI)

The mean calving interval (CI) along with SD for NBG cows is presented in table 5. Khan *et al*. (1999), Ahmed and Islam (1987) and Hasnath (1974) studied CI on RCC and their findings were 479.50±16.94, 458.40±71.82 and 485.0 days, respectively. These results are slightly higher than the findings of the present study. Habib *et al*. (2003) found the CI of RCC cattle was 409.9±17.8 days which is shorter than those in the present study. Halim (1992) studied local dairy cows and found they had an average CI of 445.0 days, which is very close to that found in the present study.

Postpartum heat period (PPHP)

The mean, SD, highest and lowest values of the postpartum heat period are shown in table 5. Information was gathered from 36 NBG cows only. Similar results had been shown by Nahar *et al*. (1989). They reported that in different breed groups PPHP ranged from 150.71±4.42 to 113.33±5.45 days.

Recommendations

The findings of the present study on the NBG cattle revealed that more systematic studies are needed to compare the production and reproductive performance of this variety of cattle with that of other indigenous cattle in Bangladesh. It is observed, however, that the NBG cattle variety is at risk both from man made and natural disasters, poverty and lack of awareness and/or interest by GO and NGOs operating in the country. Therefore, stakeholders of this cattle variety must devise and implement plans for concurrent conservation and sustainable development programs that are both practical and scientifically sound. Further, molecular characterization of NBG cattle to determine their genetic constitution is essential.

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The N'Dama cattle genetic improvement programme: a review

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Summary

This paper reviews the successful N'Dama cattle genetic improvement programme implemented in a low input production system at the International Trypanotolerance Centre (ITC) in 1994, in The Gambia. The first part of the paper presents the genetic improvement programme. The second part deals with the analysis of the genetic improvement programme. The success of the genetic improvement programme expressed through genetic progress and the benefits for the farmers is encouraging. Recommendations to strengthen the implementation process in the field are made.

Résumé

Cet article se donne pour objectif de passer en revue le programme d'amélioration génétique du bétail trypanotolérant N'Dama. La première partie de l'article fait découvrir le programme d'amélioration. La seconde partie traite particulièrement de l'analyse du programme, cette analyse se base sur le progrès génétique obtenu et les bénéfices que peuvent en tirer les éleveurs. Pour conclure, certaines recommandations pour le renforcement du programme d'amélioration génétique sont proposées.

Keywords: *N'Dama, Improvement programme, Low input system.*

Introduction

The ability of some local breeds to resist trypanosome infection has been recognised, allowing use of trypanotolerant stock to be considered one of the major methods by which sustainable animal production can be developed in tsetse-infested regions.

Open Nucleus Breeding Systems (ONBS) have been recommended in developing countries (Smith, 1988). Reports show that among the improvement programmes implemented, few are well designed, and are facing the bottlenecks of long-term sustainability and involvement of local farmers (Kosgey *et al*., 2003).

This paper reviews aspects of the N'Dama cattle genetic improvement programme implemented at the International Trypanotolerance Centre (ITC), in The Gambia.

Programme Implementation

The breeding goal

The goal was discussed and agreed upon with the National Agricultural Research Services and representatives of the target groups. In 1990, a Food and Agriculture Organization (FAO) consultancy mission was conducted at ITC. The report revealed the importance of traits like disease tolerance, milk production, meat production and ability for traction (Dempfle, 1990).

A Participatory Rural Appraisal (PRA) study was carried out in 1996 (Bennison *et al*., 1997). Based on the results, a bio-economic model was adapted utilising all known biological and economic relationships (Dempfle, 1986). This economic model was used to obtain an economic definition of the overall breeding goal. After reviewing the literature and the local production system, it was agreed in 1998 that the improvement programme should aim to increase milk and meat production without the loss of trypanotolerance and other adaptive traits.

Table 1. Overview of the chronological development of the N'Dama cattle genetic improvement programme.

Event	Period
Inception of ITC	1984
Food and Agriculture Organization (FAO) consultancy mission conducted at ITC	1990
Need for a coherent and comprehensive improvement programme expressed	1993
Proposal to support the organisation of the herd into an open nucleus herd	1993
BMZ agreed to financially support the proposal	1993
Launch of the programme	1994
Records on performance	1995
Workshop organized for breeding goal	1996
Purchase of replacement discussing animals (screening)	1996/1999
Breeding goal agreed	1998
Introduction of an animal model BLUP evaluation	1998
Introduction of mechanism to disseminate genetic progress	2001
Project PROCORDEL: enhance dissemination	2000
OPEC-FID: screening operation	2002
Establishment of two livestock multiplier associations	2002
Survey of farmer acceptance	2003

The breeding strategy

The strategy follows that of an ONBS, with selection based on individual performance and the performance of relatives. It is a three-tier scheme including the nucleus (ITC), multipliers and commercial farmers.

The following two activities can be distinguished:

1. generation of genetic progress; and
2. dissemination of genetic progress (Van Arendonk and Bijma, 2003).

To ensure that farmers use the genetic material, promotion of the improvement programme through communication with farmers and the government was very important. It involved a series of workshops, training, open days, farm visits, films and livestock shows, which demonstrated the benefits for the production of the N'Dama cattle breed.

Other programmes or activities also contributed significantly to the programme. Besides the technical aspects, socio-economic aspects have also been undertaken.

Selection criteria

Animals in the improvement programme are maintained under a low input management system and details on the production system have been described by Agyemang *et al*. (1988). Animals are selected according to an index containing information on daily weight gain (between 15 months and 36 months in a high tsetse challenge area) and the 0–100 day milk yields of all lactations. The index integrates information on the animal itself and all relatives using animal model BLUP methodology.

Selection candidates are located at the ITC's stations at Bansang (a high tsetse challenge area). The station located at Keneba maintains the breeding herd of five sires and 400 cows. Each year, approximately 400 cows are mated to produce 100 male and 100 female calves. These calves are maintained at Keneba until weaning after which 95 males and 90 females are moved to Bansang. At any one time, approximately 230 males and 225 female weaners are present at Bansang. At the end of the testing period (at 36 months of age), 84 male and 80 female animals are available for selection.

Each year one to two males are selected out of 84 candidates for replacement of the breeding males. The second best males (around 10) are designated for use in the multiplication tier, whereas all others are sold to butchers to be slaughtered. From the 80 female selection candidates, 75 are selected and mated after which 55 animals are retained based on their first lactation performance.

Training and dissemination of genetic progress

Training was the starting point for strengthening the activities of the improvement programme. The overall objective is to enhance the ability to implement genetic improvement programmes, to deal with the issues and problems faced in the management of local indigenous breeds and to cope with new technical developments for the sustainable use of local animal genetic resources.

The cattle dissemination programme started in 2001 (Table 1). As of February 2004, 44 improved bulls have been distributed to individual multipliers in 26 villages. In February 2004, 169 offspring were registered in these multiplier herds.

For the genetic improvement programme to have an appreciable impact, two livestock multiplier associations, Gambian Indigenous Livestock Multiplier Associations (GILMA-Saloum and Fulladu), were established.

Opportunities for Improvement and Evaluation of the Scheme

The evaluation is essentially based on two main interacting criteria: the genetic gain achieved during the development of the genetic improvement programme and the uptake of results by farmers. We also want to address the question of the extent to which farmers and farming communities in Gambia and the West African region benefit from changes brought about by the genetic improvement programme.

Genetic gain

Collection of performance data over 10 years has permitted the estimation of genetic parameters as well as the genetic trends for growth traits (Figure 1). The estimated heritabilities for growth traits recorded in the scheme were moderate to high (Bosso *et al*., 2002), ranging from 0.28 for weight at 36 months to 0.48 for weight at 15 months. The

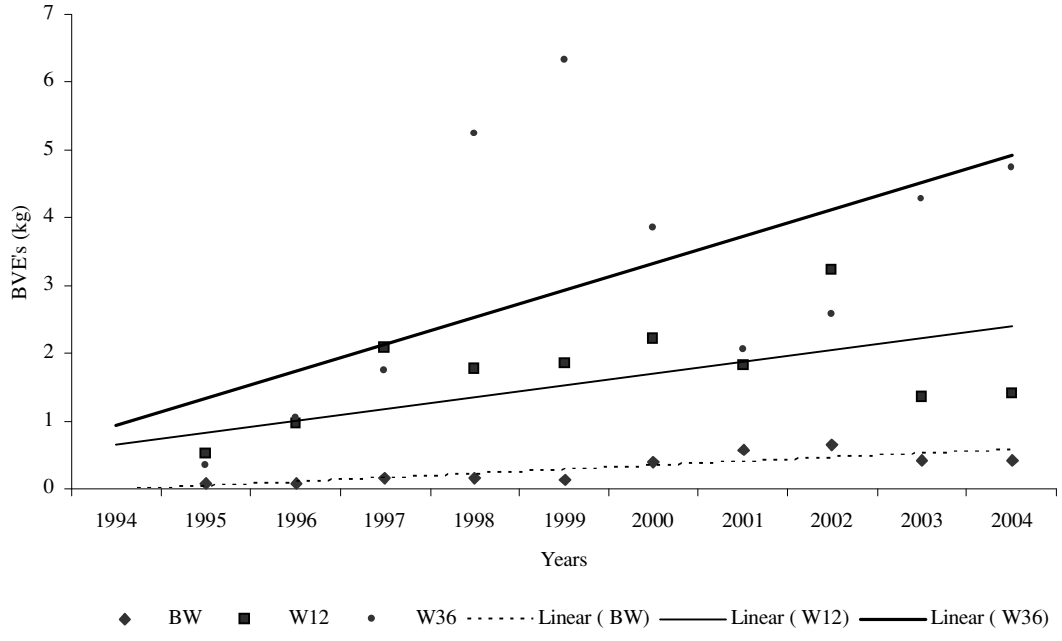

Figure 1. Figure 1. Genetic trend from 1994 to 2004 for body weight traits, showing the correlated selection responses per year for EBV of W36 (weight at 36 months of age), BW (birth weight) and W12 (weight at 12 months of age).

Figure 2. N'Dama cattle in its environment.

genetic correlation between weaning weight and weight at 36 months was high (0.69). Genetic and phenotypic parameter estimates are scarce in pure bred indigenous N'Dama cattle populations (Figure 2) and coupled with the results of the heritability factors, they support the promise of genetic improvement with respect to growth rates.

Average estimated breeding values (EBV's) of animals were calculated. The estimated increase in breeding value for W36, from 1994 to 2004, fluctuated between 0 to 6.32 kg.

W36 exhibited the largest genetic gain with a response of 0.40 kg per year. The other weight traits also exhibited positive, although smaller, amounts of genetic gain.

Support to farmers' associations

The newly formed associations remain fragile and more work is needed to strengthen them to improve their access to innovations, markets and services that enhance farm productivity and income. It is also essential to make the members of the associations aware that these associations are first and foremost instruments for them and respond to precise needs.

Interaction with farmers

A survey was conducted in 2003 in The Gambia. The objective was to assess the adoption of the genetic improvement programme. One of the most important benefits to farmers is the savings generated by the utilization of improved males; the cost of trypanocide drugs to control trypanosomosis and other diseases is drastically reduced (50%). This is very encouraging and is likely to translate in the future into higher mature live weight of animals and therefore higher sale prices.

Utilization of Indigenous Breeds

Given the encouraging results of the N'Dama genetic improvement programme in The Gambia, it has been shown to play an important role in the conservation and utilisation of N'Dama cattle. The programme has significantly influenced the utilisation and development of the N'Dama breed.

Benefits to farmers and cost of the improvement programme

The programme meets the important characteristics required for estimating incremental cost, because:

1. it addresses national development goals;
2. it is technically feasible;
3. it is economically attractive, while remaining broadly consistent with political and social constraints;
4. it is environmentally reasonable; and
5. it is financially realistic.

It appears that the N'Dama cattle genetic improvement programme will also benefit countries other than The Gambia.

Conclusion and recommendations

The N'Dama cattle improvement programme demonstrates that genetic improvement programmes for a low input production system are feasible. The success of the programme is expressed by the genetic progress achieved and this success has been transmitted to the farmers through the involvement of farmers and farming communities.

Acknowledgments

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